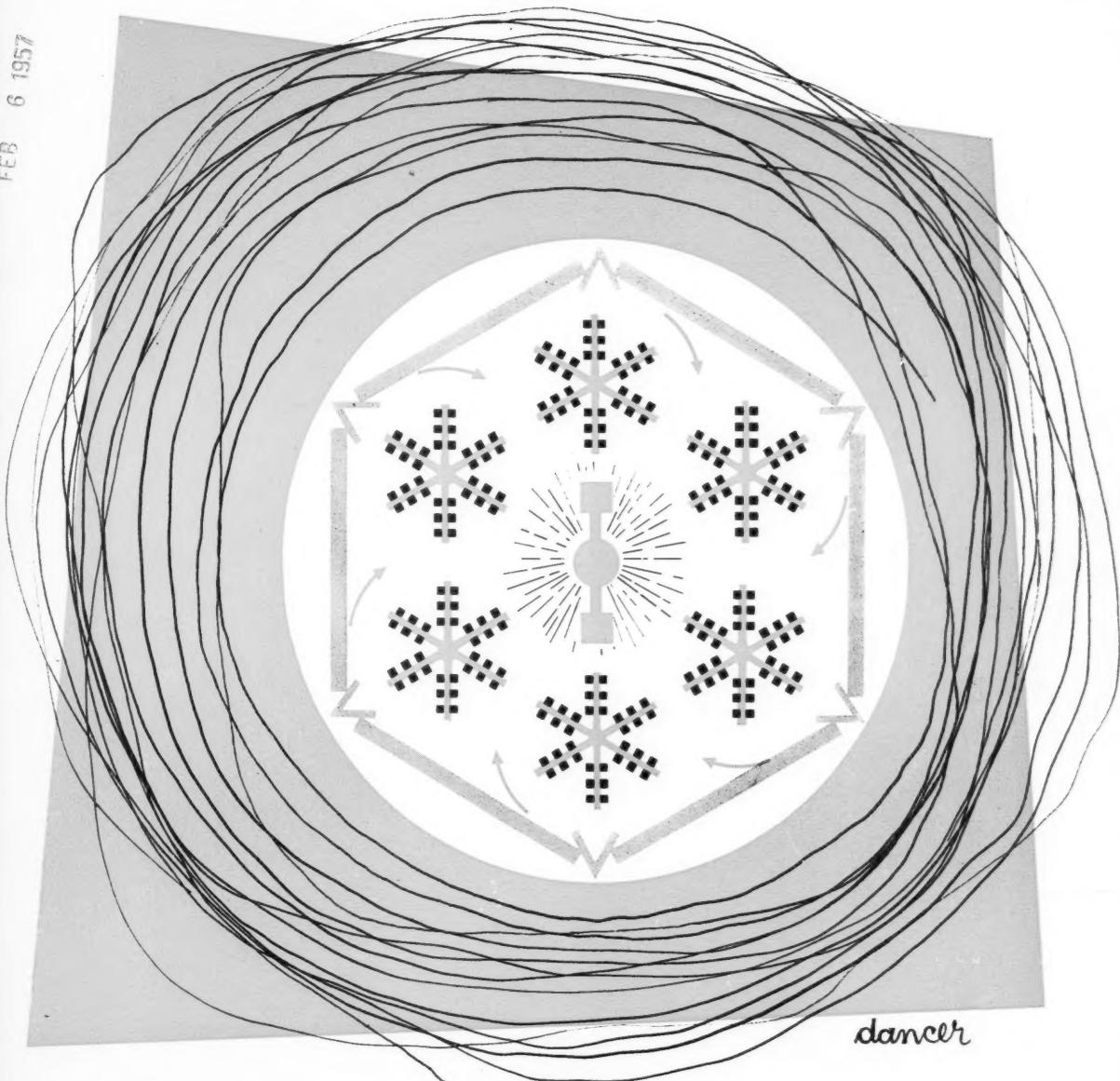


Design Engineering

FIVE DOLLARS A YEAR

FEB 6 1957



dancer

THE VACUUM METALLIZING PROCESS (Page 36)

Sun's energy harnessed in furnace

Mighty midget electronic tubes

Ultrasonics for liquid processing

October 1955

PUBLISHED BY MACLEAN-HUNTER PUBLISHING COMPANY, LIMITED, TORONTO, CANADA

"KINGSTRONG" CUTS COSTS

**Fully-insulated industrial walls
for only \$1.00 to \$1.30 per sq. ft.!**

Using two sheets of 0.032 inch Alcan "Kingstrong" Aluminum Industrial Siding — and as little as one inch of insulating material between them — you can get an insulating value greater than 16 inches of solid brick wall.

Such a wall can be fabricated in the shop or in the field. Material, field fabrication and erection costs (average installation of 200 squares) total between \$1.00 and \$1.30 per square foot.

This is just the beginning of "Kingstrong" economy. No chipping or cracking; you need order only your exact requirements. No expense for painting — low maintenance! Rust-proof all the way through, "Kingstrong" outlasts other materials many times, even in marine and industrial atmospheres.

Along with these advantages you get such other "Kingstrong" qualities as: fire-resistance, heat reflectivity, light weight, and strength. These properties make Alcan "Kingstrong" first choice for roofing and siding, warehouses, mine buildings, dock structures and factory buildings of all kinds.

For complete information, ask your "Kingstrong" dealer, or nearest Alcan Sales Office.



"KINGSTRONG" is a registered Trade Mark for aluminum sheet manufactured by Aluminum Company of Canada, Ltd. It is corrugated by:—

ROBERTSON IRWIN LTD.
Edmonton, Hamilton, Montreal, Toronto,
Vancouver, Winnipeg.

ROSCO METAL & ROOFING PRODUCTS LTD.
Calgary, London, Montreal, Ottawa, Quebec, Regina,
Toronto, Vancouver, Winnipeg.

VIC METAL INC.
Montreal, Victoriaville, Que.
With agents across Canada

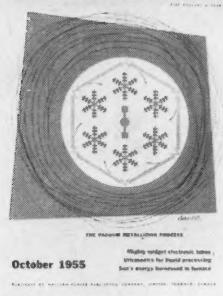
ALCAN

ALUMINUM COMPANY OF CANADA, LTD.

Calgary • Halifax • Hamilton • Montreal • Ottawa • Quebec • Toronto • Vancouver • Windsor • Winnipeg

Alcan "Kingstrong" was the time-saving, money-saving selection for gravity mill and concentrator of Eldorado Mining and Refining Ltd. on Great Bear Lake.

Design Engineering



This month's cover

Artist Don Dancer went to great pains in preparing this cover, as can be judged from the intricate detail he has shown. The mass of green color represents atmospheric pressure outside the metallizing chamber, in sharp contrast to the vacuum which exists inside it. The six curved arrows indicate the rotary motion of the racks on which the parts are supported, whilst the lines radiating from the centre show the spray action. The story is on page 36.

Design Engineering

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Design Engineering

VOLUME 1 OCTOBER, 1955 NUMBER 7

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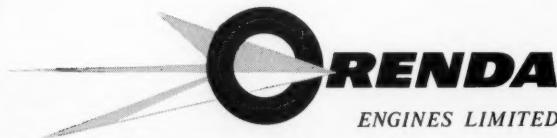
HERE'S CHALLENGE, OPPORTUNITY—Orenda Engines Limited offers opportunities to qualified Design Engineers, Development Engineers and Aerodynamicists in the new and challenging fields opened up in its work on the propulsion equipment of tomorrow. Write today to Personnel Manager, Orenda Engines Limited, P.O. Box 4015, Terminal "A", Toronto, Canada.

The skill and ingenuity of Orenda's engineering team, the precise workmanship of her production force, are superbly demonstrated in this working cutaway showpiece Orenda 11.



Main entrance to the plant where more than 2500 Orendas have been built in little over two and one half years.

In England, in Europe, in Canada, Orenda-powered Sabres and CF-100's of the Royal Canadian Air Force daily demonstrate leadership in their respective fields. Now Orenda Sabre 6's have been chosen for the South African Air Force "after giving consideration to all the best jet fighters now in production"—another tribute to Orenda power.



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A.V. ROE CANADA LIMITED—MEMBER, HAWKER SIDDELEY GROUP

Design Engineering

Inside

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Editorial correspondents in: The United Kingdom, the United States, Germany, France and Italy.

The November issue of **Design Engineering** will carry strong feature articles written by contributors no less experienced than those featured this month.

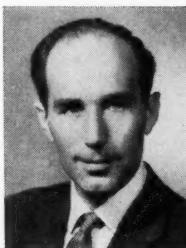
The heat treatment of aluminum, an important subject, is dealt with comprehensively from the aspects of theory, equipment and operating techniques.

Stresscoat is a brittle coating expressly developed to simplify and reduce the time and the cost of experimental stress analysis.

Special Artwork
Editorial layouts designed by art consultant **Desmond English**.



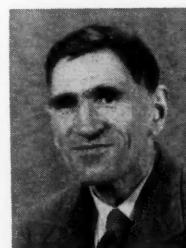
Seiter



Rose



Oates



Thomson

THE MAIN FEATURE of this issue deals with the important subject of vacuum metallizing.

The article is by **J. Gordon Seiter**, recently appointed manager of the High Vacuum Division of F. J. Stokes Machine Co.

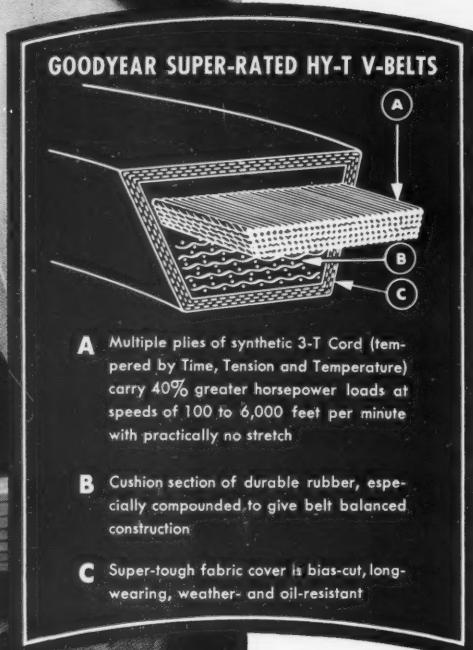
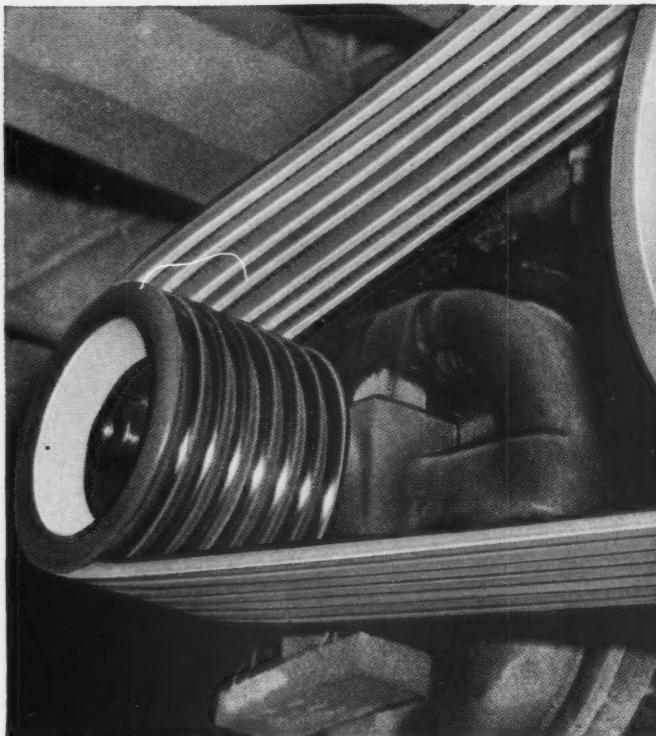
Gordon Seiter joined that firm as head of vacuum metallizing sales, after having been General Manager with a firm specializing in high vacuum gauges, pumps and other scientific instruments. A prolific author and frequent speaker on the subject of vacuum metallizing at meetings of the learned societies, his outdoor hobbies are the all-absorbing and somewhat conflicting ones of fishing and golf. Chess and tropical fish breeding amuse him indoors.

THE ARTICLE ON ultrasonic processing has been contributed by **F. Rose**. He received his engineering training in England and later specialized in switch gear and industrial measurement and control. In his present capacity of industrial consultant, he assists British engineering concerns who wish to enter or expand in the Canadian market. He has taken a particular interest in mechanical ultrasonics, an outstanding British development, and writes with the authority of his personal experience.

THE AUTHOR OF the article "Light Rays Keep out Draughts" is **J. A. Oates**, an apprentice-trained engineer with twenty years practical experience in British factories. For several years he was associate editor of a leading British engineering journal and is now a freelance technical journalist covering all branches of engineering.

AUTHOR OF the article on marine turbines, **A. G. Thomson**, was born in Glasgow in 1904 and educated at Uppingham. He went to South Africa in 1925 and farmed for ten years in the Orange Free State, but abandoned farming for journalism in 1934. For many years, he has specialized in scientific and technical journalism. Since returning to England in 1949, he has been engaged entirely in freelance journalism and has contributed to many leading publications.

The SECRET of SUCCESS...



is matching!

High speeds and tough shock loads are the efficiency robbers that cause some belts to stretch, to lose their grip or break on multi V-belt drives. Goodyear found the answer to this problem.

The secret of success is matched sets of HY-T V-BELTS. These sets are matched for length, strength, weight and balance. Goodyear matching assures equal distribution of work load for uniform efficiency and exceptionally long service life.

Goodyear HY-T V-BELTS are sinewed with Triple Tempered (3-T) Cords to provide 40% higher H.P. ratings—7 belts can do the work of 10—or the same number of belts will substantially increase belt service life. Goodyear HY-T V-Belts have oil resisting covers, are mildew inhibited and can be supplied static-conducting.

Each Goodyear Branch has the necessary matching equipment to supply the "sets" to harness your belt killer drives.

GOOD  **YEAR**
INDUSTRIAL RUBBER PRODUCTS ENGINEERED FOR THE JOB

For complete information write or call
your nearest Goodyear office at—
Moncton, St. John, Quebec City, Montreal,
Toronto, London, Windsor, Winnipeg,
Regina, Saskatoon, Calgary, Edmonton,
Vancouver, or Head Office, New Toronto.

Reports

News in brief from the world's producers

MONTREAL—A Pageant of Power will be held here in the Show Mart November 8-11 in conjunction with the annual convention of the **Institute of Power Engineers**.

The show, a meeting place for the power equipment manufacturer and buyers, will be open from 10 a.m. to 10 p.m. throughout the four day program.

Major engineering companies will sponsor displays, technical sessions and motion pictures.

Most power methods will be represented with particular emphasis on steam, diesel, gas turbines, fuels, control engineering, air conditioning, refrigeration, atomic energy and heating.

Four technical sessions will include an address by I. G. Wilkey of Peacock Brothers, designer and operator of the Naval Testing Laboratory. Other sessions will cover boiler room design, fuel selection, and function of the operating engineer in an atomic energy plant.

NEW YORK — Beryllium Metal, whose major importance lies in atomic energy applications, where it is used as a moderator for nuclear reactors, will soon find wider markets as a result of a new refining process which reportedly cuts its cost as much as 75%.

The new process announced by the **Light Metals Refining Corporation** marks a new approach to chemical and metallurgical technology.

Known as the Sheer-Korman High Intensity Arc Process, it has never before been used in a chemical process.

Dr. Charles Sheer, co-inventor of the system and vice-president of the company describes the use of the high intensity arc as similar to the arc produced in large military searchlights.

A "control type" plant to be built in the New York area by the company, is expected to produce 10,000 lb. of beryllium a year.

Designed to combine production with research the plant will receive some income during the time it is perfecting the process.

PHOENIX — Scientists from around the world will converge on this Arizona city November 2-4 for the **World Symposium on Applied Solar Energy**.

As a prelude, the delegates will attend meetings October 1-November 2 at the University of Arizona, Tucson, where an

exchange of ideas on fundamental principles in the uses of solar energy will take place.

Prime object of the earlier meeting is to assist scientists in charting the direction of future research.

LONDON, ENGLAND—A permanent exhibition of well-designed British products will be opened in the West End here early in 1956.

The exhibition site at 28 Haymarket will display products selected by the **Council of Industrial Design** (CoID).

High standard of design in the products, mainly durable consumer goods, is expected to impress both domestic and overseas buyers.

Located in the same building will be the photographic and book libraries, the Record of Designers, Design magazine and CoID offices and conference room.

A trade information service and Design review, an illustrated index of British goods well designed, will be available for reference.

At this year's CNE a display of over 600 British products was a follow-up of the U.K. promotion plans.

Selected from 4,000 original items, the display, called Modern U. K., featured products which have won the approval of the council of designers sponsored by the British Board of Trade.

STREETSVILLE—Radioactive signs, made of radium oxide on porcelain enamel, which were used in German cities during World War II blackouts, are being manufactured.

factured in this Ontario town by **Graham Bell** against German patents under a working agreement with the Bettiner Corporation of the U. S.

Adaptable to wartime emergencies, the signs are well suited for civil defense programs. Ideal for street signs and directional signs, they are impervious to all types of weather and atmospheric conditions. This feature makes them especially useful for battleships, aircraft and military installations.

The enamel, when directed to peacetime uses, can be applied to countless objects in industry and home which are difficult to locate in the dark.

Even when stored in large quantities, the makers claim the signs contain radioactive ingredients far below the toxic level.

TORONTO—One of Canada's best known distributors and sales representatives has added the **Lundy Manufacturing** line of actuators, Aeromotors and Iris-Flo valves.

Anthony Foster with sales offices across the Dominion represented Philco for nearly thirty years until the company opened direct sales offices in Canada.

The Lundy units, with extensive application in the American aircraft industry, will be marketed by Anthony Foster's aircraft division.

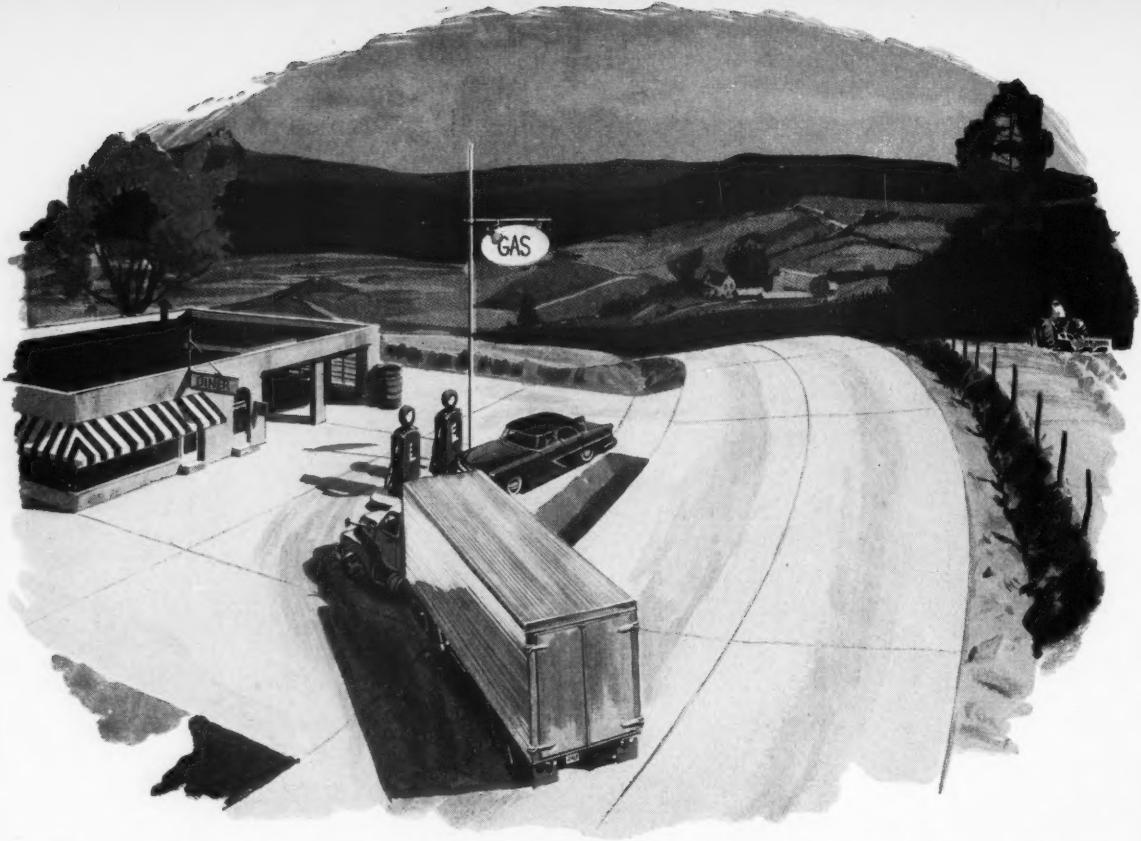
THE U. S. NAVY'S first two guided missile cruisers, the USS Boston and Canberra, will be armed with the **Convair Terrier**.

Newest anti-aircraft guided missile, it is capable of supersonic speeds. It can find and destroy its target under any conditions of visibility or weather.

Far deadlier than even the largest anti-aircraft guns, the Terrier was developed for the Navy Bureau of Ordnance by Convair Division of General Dynamics, with technical direction by John Hopkins University Applied Physics Laboratory.

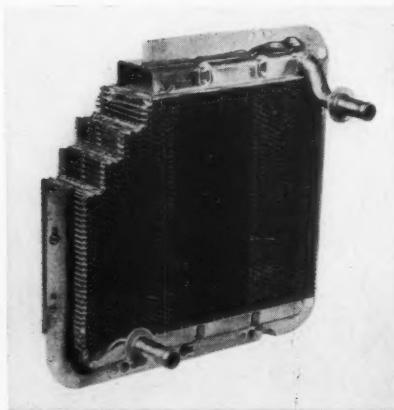


Guided missile rips from deck to destroy target



Canada's automotive industry gears for the future

... and Noranda lends a hand with copper-base alloys



The outstanding heat-transfer ability of copper is used to advantage in applications like this automotive heater radiator.

A major factor in Canada's industrial growth is the productive power of its automotive industry. This progressive industry is turning out passenger cars, buses, trucks, tractors and military vehicles of all types to help keep the country's great industrial output rolling, now and in the future.

Here, too, Noranda lends a hand, supplying copper and copper-base alloys that perform many essential automotive functions. Noranda high-quality metals are used in the fabrication of parts such as machined fittings, ignition systems, accessories, headlights, radiators, heaters, and many others.

Other fast-growing industries are being similarly served by Noranda metal products. If you need copper, brass or bronze, sheet, strip, tube, rod or wire, get in touch with Noranda. We'll be glad to fit our service to your particular needs.



Noranda Copper and Brass Limited

A Fabricating Subsidiary of Noranda Mines Limited

Sales Offices: Montreal • Toronto • Windsor • Edmonton • Vancouver

HERE IT IS

Cleveland Speed Variator



NOW available in 9 sizes, ranging from one-half to 10 horsepower at 1750 input RPM.

INFINITELY variable, stepless speeds within a 9:1 range (from $\frac{1}{3}$ to 3 times the input speed).

Smooth, instant change of speed by simple manual adjustment or by remote control devices, either manual or power operated.

Operating efficiencies—75% to 90%.

Coaxial input and output shafts, rotating in same direction, either clock-wise or counter clock-wise.

Ample bearing support for both input and output shafts to carry overhung pulleys.

Compact and inherently quiet and smooth running, due to simple construction.

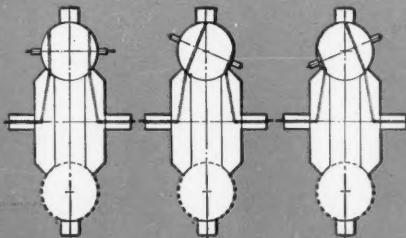
Minimum maintenance and long life, due to absence of belts and other complicated linkage.

Performance proved by prolonged tests in the laboratory and field operation.

These are the outstanding advantages of the Cleveland Speed Variator. It is now ready for service. Immediately applicable to a wide variety of machines and equipment where a dependable variable speed drive is required.

For detailed description and specifications, write for Bulletin K-200, Peacock Brothers Limited, P.O. Box 1040, Montreal, Que.

HOW THE CLEVELAND SPEED VARIATOR WORKS



Power is transmitted from input shaft to output shaft through alloy steel driving balls which are in pressure contact with discs attached to the two shafts.

Relative speeds of the shafts are adjusted by changing the positioning of axles on which the balls rotate (see diagrams, left, and cutaway view, right).



PEACOCK BROTHERS LIMITED

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SYDNEY • TORONTO • SUDBURY • WINNIPEG • EDMONTON • CALGARY • VANCOUVER

Now... one tool, one die set installs

3,000-lb. crimping force, plus range of standard interchangeable die sets, installs any type of compression terminal on wire sizes from AN26 through AN8.

HYLUGGE



MANUAL for small quantity production. Rachet control and shouldering dies maintain uniform, correct depth of indent. 1 $\frac{3}{4}$ lbs. 10 $\frac{3}{4}$ " long.

—and for heavy volume production

INVESTIGATE THE BURNDY BANDOLUGGER

...the completely automatic wire-terminating machine! Bandolugger performs thousands of perfect wire terminations per hour with banded reels of Burndy Insulugs for wire sizes No. 22 through No. 14; stud sizes from No. 4 through $\frac{5}{16}$ ". Single die installs 19 terminal variations without adjustment! Automatically rejects inadequately stripped wires. Safe — fully enclosed for operator's protection.

Write for Bandolugger Bulletin 54SME



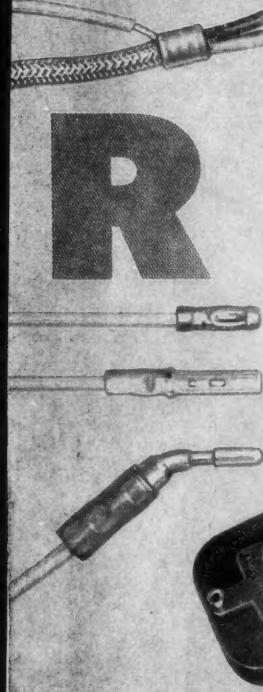
B

red, blue, and yellow terminals

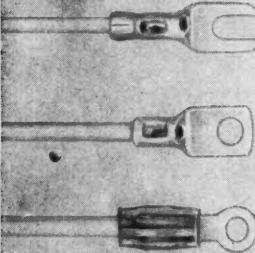
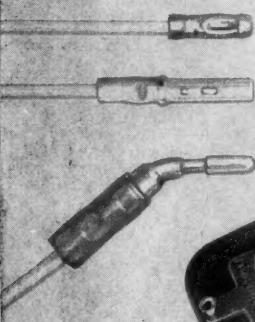
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(16-14)

(12-10)



R



BURNDY

NORWALK, CONNECT.—TORONTO, CANADA • Factories: NEW YORK, CALIF., TORONTO • Export: PHILIPS EXPORT COMPANY

REPRESENTED IN WINNIPEG BY NORMAN L. HANEY & CO.; CALGARY AND VANCOUVER BY BUNSTON LTD.

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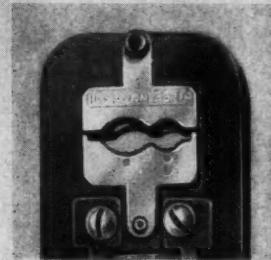


PNEUMATIC for high volume production at the bench or jig board.

When small trigger near head is depressed, ram die retracts, connector-and-conductor assembly is inserted between jaws, and trigger is released. Spring loading holds assembly in place until crimped by depressing the actuating lever.

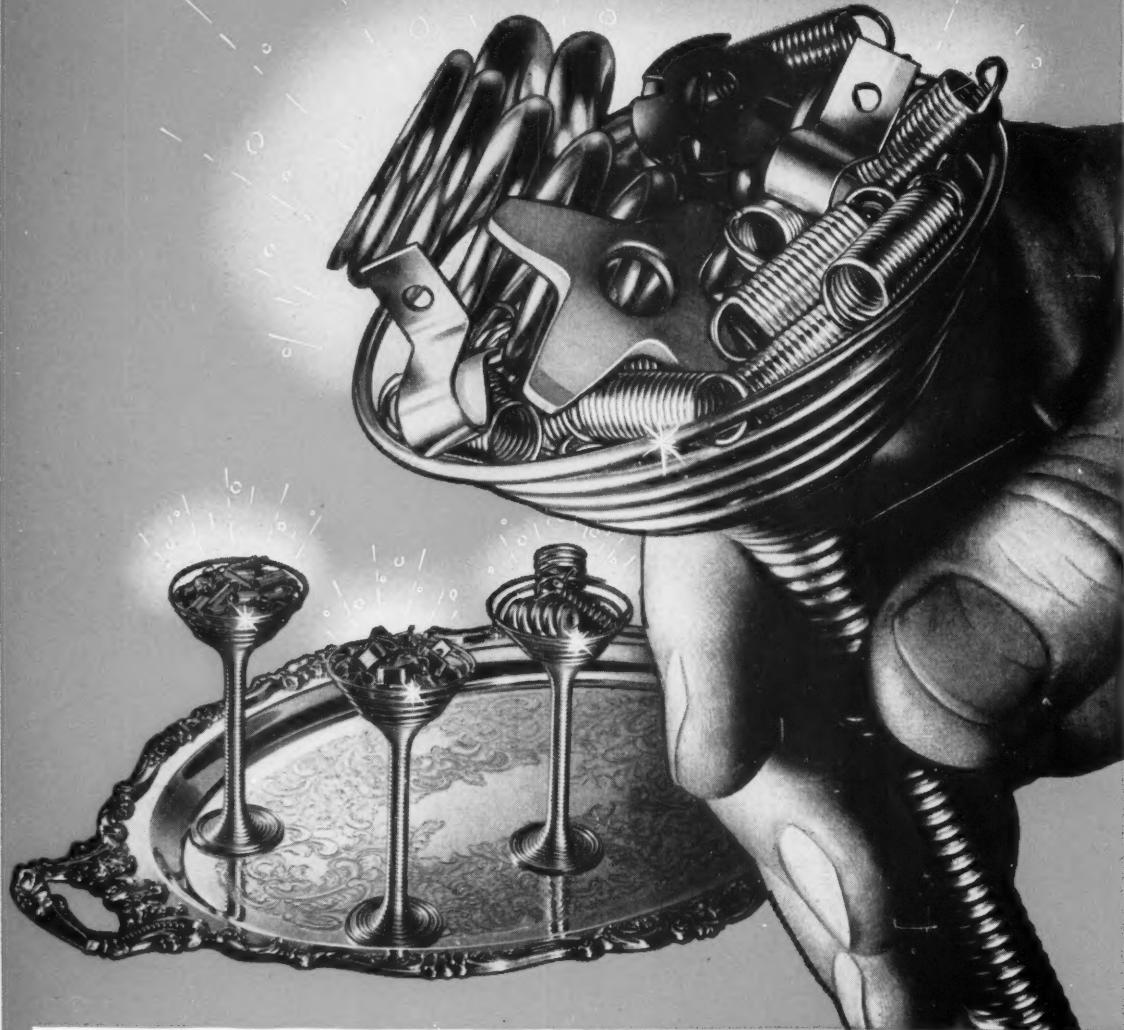
Full cycling control and shouldering dies insure correct, uniform completion of each crimp. $2\frac{3}{4}$ lbs. $9\frac{1}{2}$ " long.

Lightweight, compact, and with small heads for tight working quarters, these versatile tools offer new speed and reliability for small wire termination. Heat treated alloy steel parts stand long rugged use. Write for Bulletin YAE54.



All die sets may be used interchangeably in the manual Hylugger MBND or the pneumatic YBND. Locking adjustment on dies compensates for wear over long periods of service—prolongs life and effectiveness of die sets.

"To the success of your mechanism"



Wallace Barnes SPRINGS

The Wallace Barnes Co. Ltd.

HAMILTON, ONTARIO



Now!

**Industry's
Most Versatile
Power Transmission
Medium!**

**DOMINION
RUBBER**

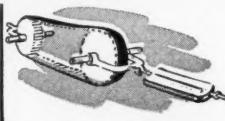
"TIMING BELTS"



CAN'T SLIP
Positive engagement ends slippage, creeping, power loss. Speed ratio can't vary.



NO LUBRICATION
Absence of metal-to-metal contact ends lubricating problems, and cuts cost and weight.



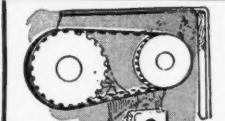
NO INITIAL TENSION
Lighter, cheaper bearings are possible since initial tension is not required to prevent slippage.



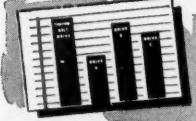
WIDE H.P. RANGE
H.P. Range is 1/100 to 300 or more. Stock drives to 50 h.p. Larger belts and pulleys made on order.



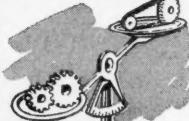
HIGHEST BELT SPEEDS
Light weight holds centrifugal force to minimum, allowing belt speeds previously impossible.



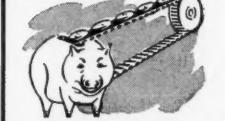
SLOWEST BELT SPEEDS
Timing belts operate with absolute accuracy at speeds so slow as to be imperceptible to the eye.



HIGHEST EFFICIENCY
No friction-creating joints, negligible heat build-up, no slippage, no lube drag, minimum bearing load.



LIGHT WEIGHT
"Heavy duty" belt 1" wide (tensile strength 2500 lbs) weighs 0.1 lb. per linear foot. Permits short centres, high ratios.



ECONOMICAL
Long service life, competitive initial cost, no lubrication, minimum maintenance, easy installation, savings in design.

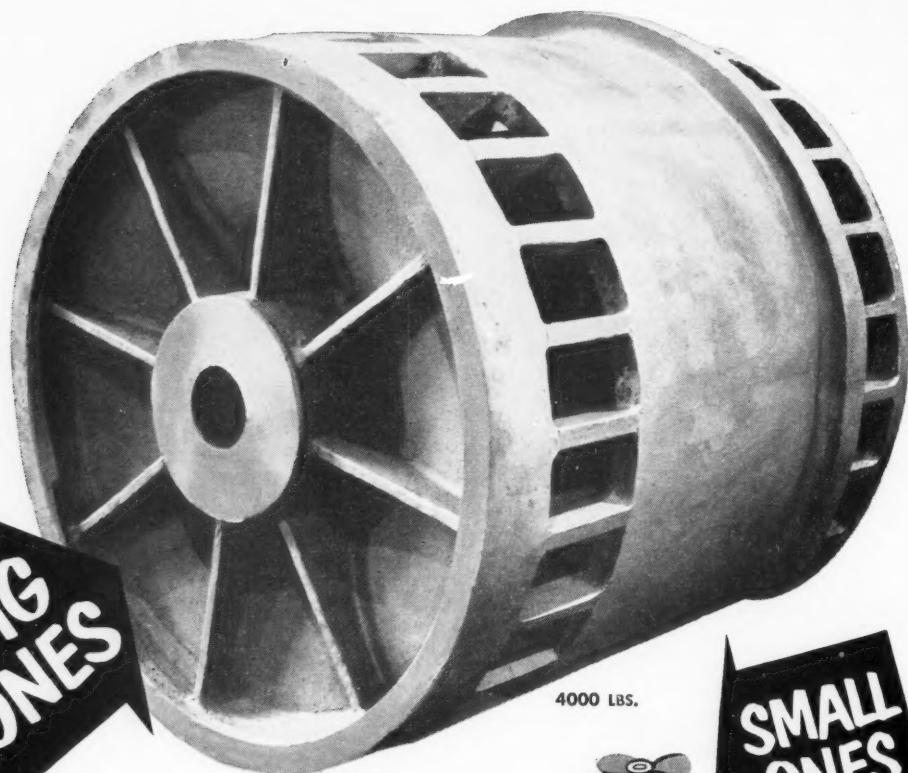
MORE FLEXIBLE than all other types of transmission belting, quieter than chains, positive as gears, the new "Timing" Belt Drive offers engineers many opportunities to improve performance and obtain greater overall economy.

Neoprene backing and neoprene-imregnated nylon fabric facing provide maximum protection and wear resistance. Tension members give exceptional strength and flexibility.

For complete information on how "Timing" Belt Drives can help solve your power transmission problems, contact the closest Dominion Rubber Company Limited branch office, or 550 Papineau Ave., Montreal, Que.



STAINLESS STEEL CASTINGS



Shawinigan Chemicals makes a wide range of stainless steel castings — large or small, simple or intricate. Regardless of size or type of stainless steel, Shawinigan will turn out the castings needed to handle YOUR heat or corrosion problem.

Our Technical Staff will assist you gladly.

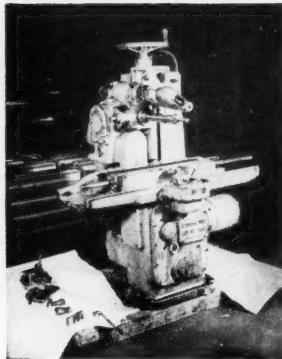


SHAWINIGAN CHEMICALS LIMITED
STAINLESS STEELS & ALLOYS DIVISION

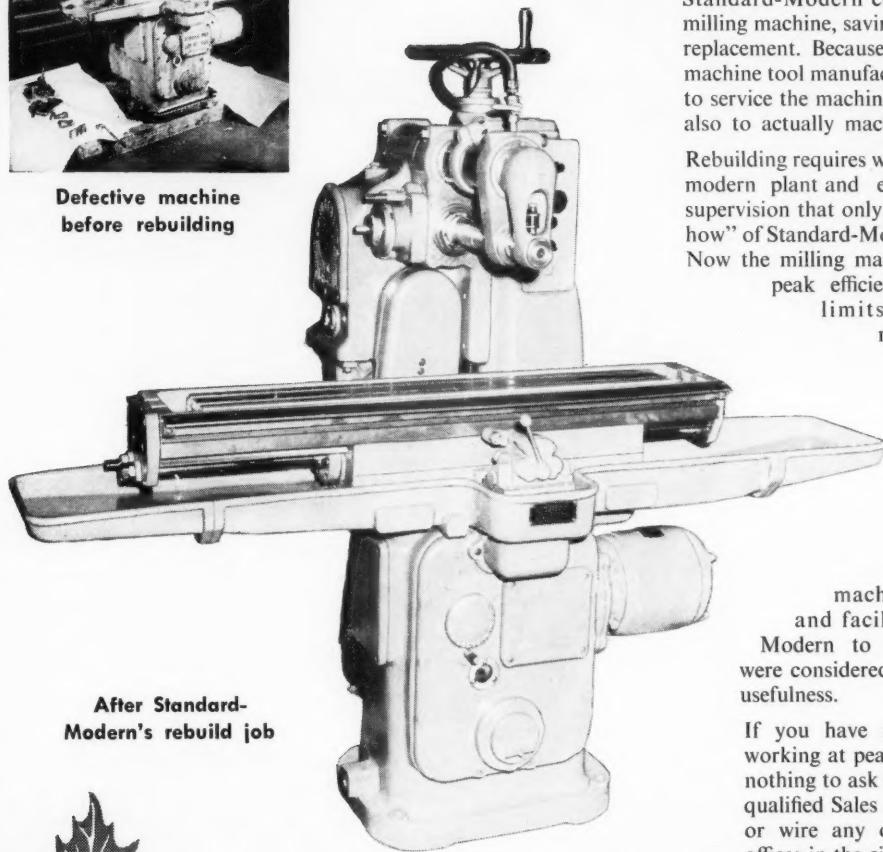
HEAD OFFICE: SHAWINIGAN BUILDING, MONTREAL

— — — PLANTS: SHAWINIGAN FALLS

How one manufacturer avoided a capital expense of \$9,000



Defective machine
before rebuilding



After Standard-
Modern's rebuild job



STANDARD-MODERN TOOL CO., LTD.
TORONTO CANADA

Sales Division: The A. R. WILLIAMS MACHINERY COMPANY LIMITED

Halifax, Montreal, Ottawa, Toronto, Windsor

*by rebuilding
this machine tool*

Standard-Modern completely rebuilt this milling machine, saving its owners the cost of replacement. Because Standard-Modern is a machine tool manufacturer, it is not only able to service the machines in the usual way, but also to actually machine replacement parts.

Rebuilding requires wide experience, the most modern plant and equipment, and expert supervision that only a firm with the "know-how" of Standard-Modern is able to give you. Now the milling machine again operates at peak efficiency within Schlesinger limits, saving the cost of repairs in faster, more efficient operation.

Standard-Modern's experienced Sales Engineers offer you money-saving recommendations on rebuilding or replacing defective machine tools. Experience and facilities allow Standard-Modern to rebuild machines that were considered to have out-lived their usefulness.

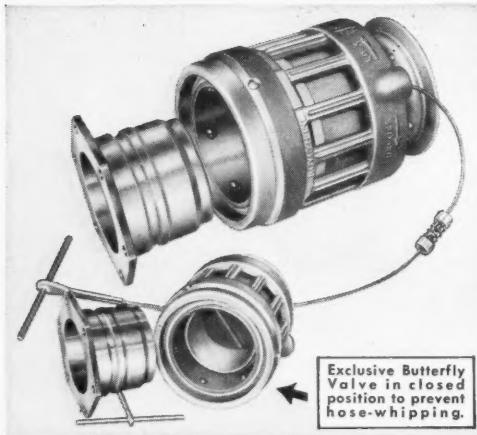
If you have machines that are not working at peak efficiency, it costs you nothing to ask for advice from our well qualified Sales Engineers. Write, phone or wire any of our Sales Division's offices in the cities listed below.

2

NEW

ROYLYN
PRODUCTS
*designed and built
for safety and
economy!*

ROYLYN air-start
coupling & hose



Here is the first Air-Start Coupling built to Air Force requirements for the 3-inch pneumatic starter system on turboprop and turbojet engines.

Performance and endurance of the Roylyn Air-Start Coupling have been proved by tests which exceeded Air Force requirements for rough handling. After more than 750 free-falls to concrete, from a height of six feet, the Coupling performed with complete satisfaction—positive proof that Roylyn Couplings are designed and built for performance and endurance, assuring you of *safety and economy!*

TIME-PROVED ROYLYN "QUICK-LOCK" PRINCIPLE
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LANYARD DISCONNECT WITH OR WITHOUT PRESSURE LOCK

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*Dominion designed and manufactured both this product,
a 7,000-ton Forging Press, and the machine tool,
a 42/52 Boring Mill.*

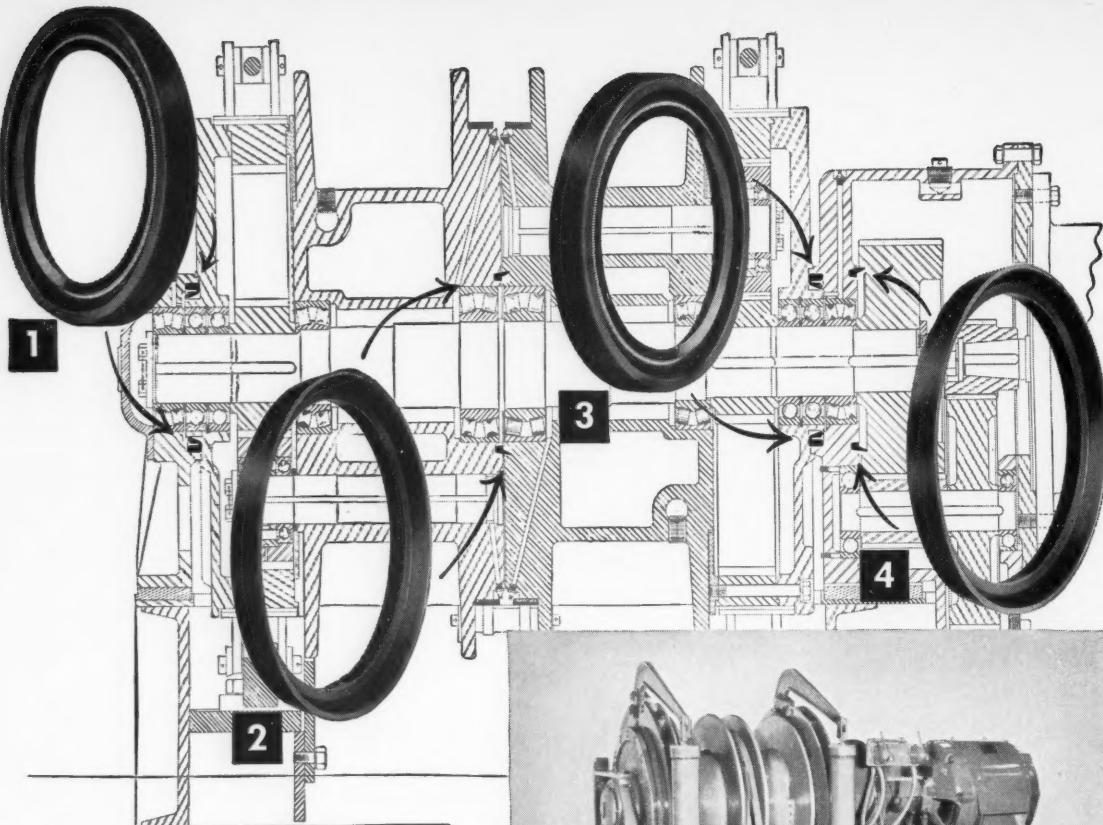
Wheels within Wheels

Dominion Engineering designs and manufactures heavy machinery and, where necessary, specialized tools to produce it.

The 42/52 boring mill illustrated above was designed and built to machine hydraulic turbine components which were physically too large to be machined on existing or available machine tools.

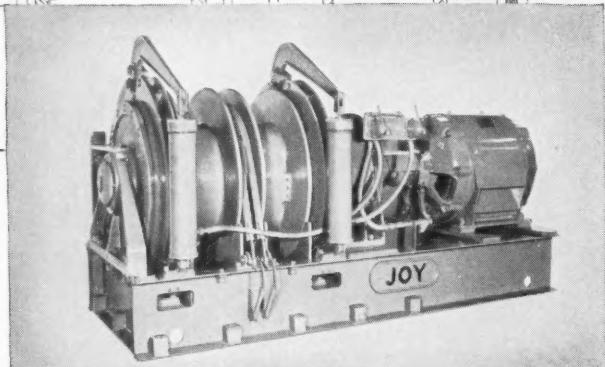
The 7,000-ton Forging Press is a typical example of a machine produced when Dominion's combination of engineering skill and vast plant facilities is put to work to meet a customer's specific need.

Dominion Engineering Company, Limited
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A TYPE OF OIL SEAL FOR EVERY SERVICE

The J-M Clipper Seals used in Joy Manufacturing Company's Double Drum Slusher Hoists are: (1) Type LPD for planetary clutch-hub to bearing-bracket seal, (2) Special Outside Lip Seal Between counter-rotating drums, (3) Type LPD seal as reduction gear housing to planetary clutch-hub seal, (4) Special Outside Lip seal for reduction gear housing seal.



Need an oil seal to withstand muck and acid mine water?

Clipper Oil Seals help Joy Mine Slushers stay underground longer

THIS 125 H.P. Double Drum Slusher Hoist made by Joy Manufacturing Company is one of the most rugged machines in underground mining service. Designed to haul rock and ore in metal mining operations, it is constantly covered with muck and mud. In addition it is subjected to acid mine waters. To work dependably, shift after shift, day after day, it must stay clean and well lubricated on the inside.

To protect its bearings from dirt and corrosion and to retain the lubricant, two types of Clipper Seals are used. Type

LPD Clipper Seals with corrosion-resistant alloy garter springs are installed on the reduction gear housing to planetary clutch and on the planetary clutch hub to bearing housing. Special outside lip springless Clipper Seals are installed between the counter rotating drums and on the reduction gear housing. This combination was effected by Johns-Manville Packing Engineers working in conjunction with the Joy Manufacturing Company engineering staff.

Clipper Seals offer many advantages, wherever accurate fit, longer life and

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ANNEALED	60,000 p.s.i. to 75,000 p.s.i.	45,000 p.s.i. to 60,000 p.s.i.	10-20%	140-180
HEAT TREATED	80,000 p.s.i. to 160,000 p.s.i.	65,000 p.s.i. to 150,000 p.s.i.	1-15%	160-340

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Light weight means economy wherever you use polyethylene, the lightest commercial plastic. One man easily carries a 200-ft. coil of 2-in. polyethylene pipe. Polyethylene carboys cut shipping costs of liquid chemicals. Wire and cable covered with polyethylene can be strung over longer spans, saving poles.

FLEXIBILITY

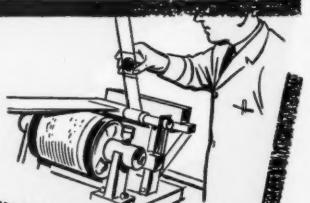
Flexibility is an inherent feature of polyethylene. It needs no plasticizers to make it resilient. The degree of its flexibility depends on its wall thickness. Squeeze bottles made from it recover their shape instantly. This quality means lower breakage costs for articles made from polyethylene.

TOUGHNESS



Toughness is another valuable property of polyethylene. A good example is this auto spring leaf pad of molded polyethylene. It stands up under constant squeezing and acts as a "dry lubricant," preventing metal-to-metal contact. It keeps out sand and grit that could abrade the metal spring leaves.

ABRASION RESISTANCE



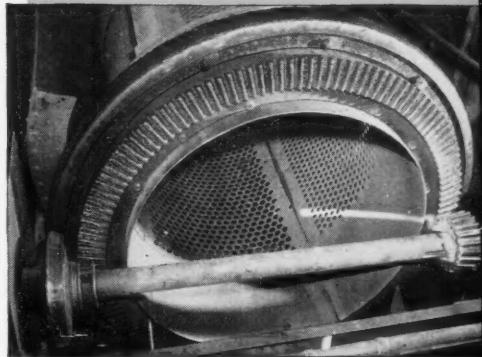
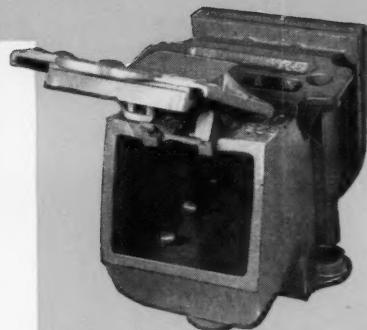
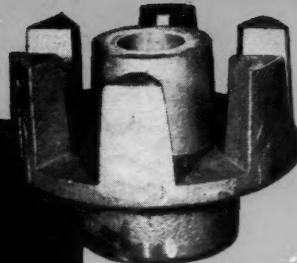
Abrasion resistance is superior in comparison with rubber-type compounds. In laboratory test using a revolving drum covered with "Aloxite" 320 metal cloth to provide continuous abrasion, rubber-type compound lost 75 to 80 per cent thickness in only 280 revolutions. Polyethylene lost 40 to 45 per cent in 2000 revolutions.

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5. It can be satisfactorily welded.
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8. It is generally more corrosion resistant than cast steel.



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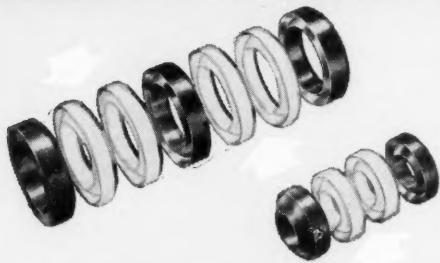
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*Look for new products, new developments in the
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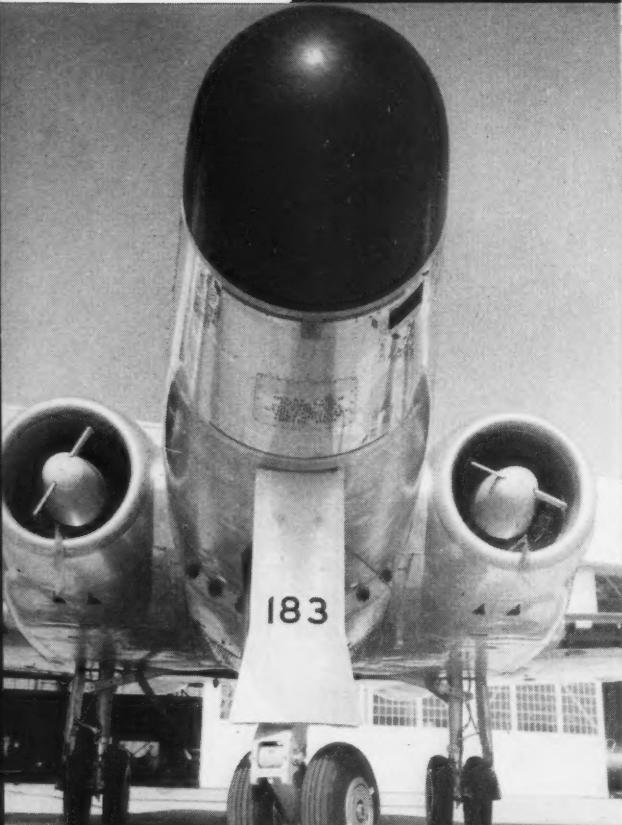
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Savings with Nickel Alloy Steels begin with the important weight reductions due to inherent high strength characteristics. Thin, light sections of these economical steels provide the same strength as thicker, heavier sections of plain carbon steels. Where space and weight limitations are of importance, as in landing gear units of aircraft, this feature of Nickel Alloy Steels becomes a safety "must".

EASILY FORMED AND WELDED

Nickel Alloy Steels often contribute to lower unit-labour costs due to their excellent performance response to usual fabrication methods. They are easily formed and welded, features which are especially suited for fabricating heavy-duty equipment requiring maximum ruggedness and stamina with minimum weight.

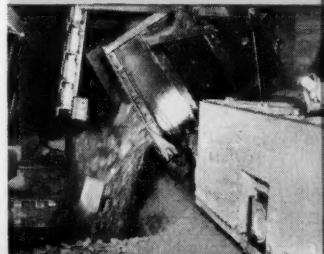
RESISTANT TO CORROSION, ABRASION AND IMPACT

Lower maintenance and replacement costs complete the savings picture with Nickel Alloy Steels. Their high resistance to conditions of corrosion, abrasion and impact mean longer service life . . . more profitable operation.

Nickel Alloy Steels are available from Canadian steel mills in a wide range of varieties to meet specific applications.



Nickel Alloy Steels contribute to economical operation of refineries where resistance to corrosion and abrasion play an important part.



Light weight and high strength are vitally important in the construction of mine cars and skips, trucks and highway bus bodies.

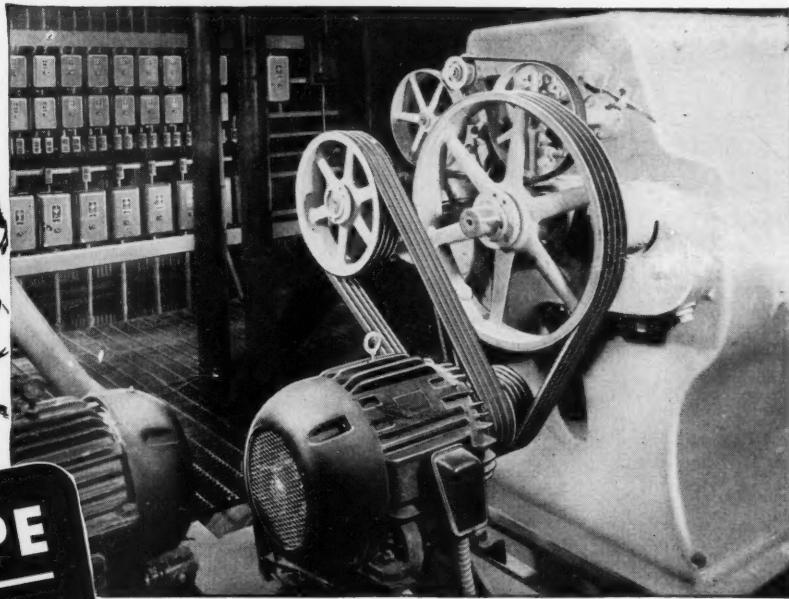


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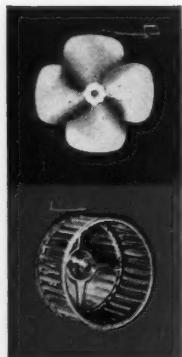
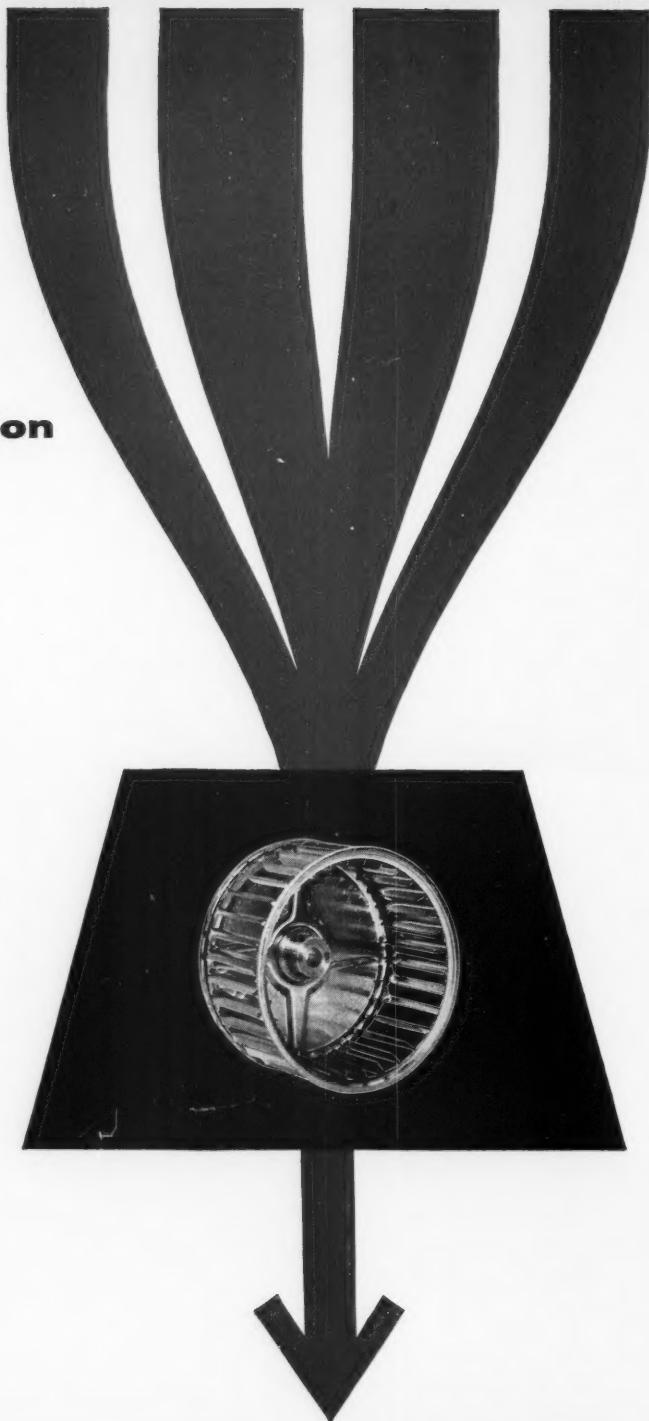
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specify Torrington AIRotors

Torrington AIRotor blower wheels are available in three general categories: single wheel (illustrated), double wheel, and the "X Type" double inlet wheel. Sizes range from $1\frac{1}{2}$ " in diameter and $\frac{5}{8}$ " in width to 11" in diameter and $11\frac{13}{16}$ " in width. Special spline, jaw, or short hubs are also available.

Torrington's unusually broad product range and great manufacturing capacity can provide... quickly and at low cost... the fan blade or blower wheel that's best suited to your air-moving requirements.

Torrington also maintains a complete research and testing service to assist you in the solution of any design problem relating to air flow, sound or vibration.

No one has had more experience in the design and production of air impellers than Torrington. Nowhere else can your dollar buy so much in terms of product quality and customer service.



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VIP's

Important people who are in the news

IS THERE a future for Canadian radar apart from defense uses?

Brigadier F. C. Wallace, D.S.O., M.C., who has just joined the Board of Decca Radar (Canada) Limited, gives an emphatic "yes."

President of Canadian Pittsburgh Industries and knee-deep in the administration of several other companies, the Brigadier should know whereof he speaks.

Loaned to the Canadian Government by the British Army, he came to Canada early in 1940 as director of the radio division, National Research Council. In this capacity, he was vice-president



Brig. Wallace, for radar

of manufacturing at Research Enterprises where he led radar production.

Optimistically, he believes Canada should stay in the forefront of the industry as she has done in the past.

"We were right in the front row with radar throughout the war and have remained there since," he maintained.

Then, with his attractive, slight Irish accent, the Brigadier described the new applications of radar apart from defense.

He outlined in particular the potential of radar in the marine and aviation industries.

Heading the Canadian company, a subsidiary of Decca Radar England is Thornton Cran, one-time director of

Rogers Majestic Electronic Enterprises.

Portraying industrialist Wallace as one of Canada's substantial businessmen, he looks to his new board member as a valuable partner in the radar field.

Canada can be sure that the dapper, erect, sports loving Brigadier will help to guide the destiny of the industry to a dynamic success, keeping us as he says, in the front row.

MOST OF CANADA'S better designers are listed as members of the official Association of Canadian Industrial Designers. Recently they elected their new president for 1955-56, John Ensor, of Toronto.

As surprised as any one at the news, was the new president himself. He had proposed that the retiring president, Henry Finkel, be re-elected, then discovered the rules did not allow the office to be held by the same man for more than one year. John Ensor, who had not asked for the association's top job, found that he had got it.

What does he plan to do to push the association forward? More than anything else, he has told DESIGN ENGINEERING, he plans to increase the membership.

A mobile display is soon to go into action as part of this plan to catch the attention of manufacturers and consumers, many of whom know little of ACID.

Of Canadian industry, the new president said this: "It still hasn't sufficient confidence to think things can originate in Canada. Here is a problem ACID means to face." He is currently up against this lack of confidence himself. A new Ensor-designed portable slide viewer is going to have to be merchandised in the U. S. If it is successful there, it will come back to Canadian markets. This is not unusual to designers in this country who are well used to the frustrations of an overly timid industry.

John Ensor is 50 years old, quiet spoken and popular among members. He has the backing of the 30-strong association in the membership drive, hopes that when his term of office ends he will look back on twelve months of achievement with one of Canada's youngest professional associations.

John Fenton, the five-foot-seven, dark-complexioned manager of RCA Victor's new television parts plant at Renfrew, Ontario, looks back over 28 years' service with the company.

What are his views about the radio

and TV industry after nearly three decades of producing sets for Canadians? Veteran Fenton surveys with enthusiasm his career which began in 1927.

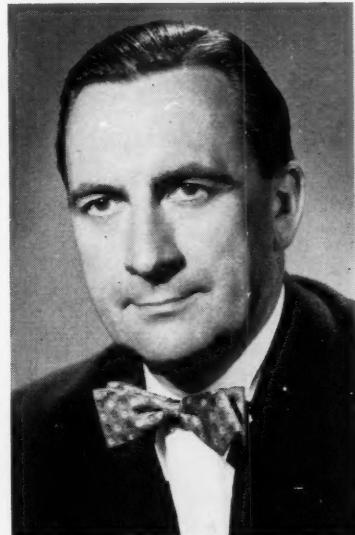
Then, radio fans sat by their battery-operated superhets pulling in programs from Toronto, Montreal, Regina, Winnipeg, and the Voice of the Prairies in Calgary. There were other Canadian radio stations, too, and many American stations which could be picked up as well.

The following year the company put their first ac-dc receiver on the market. Sales zoomed.

"What has happened to short-wave in radios?" Design Engineering inquired of Manager Fenton, who became a product design engineer in 1937 after ten years' experience in the RCA research labs in Montreal.

"Too costly," came his reply, "in proportion to building a standard set."

"RCA Victor," he continued, "maintains a leadership in the radio and TV



John Fenton, for TV

field through the tremendous amount of research and development that is going on constantly in their labs."

"Color television is actually well under way," Manager Fenton claimed, "and we are ready to adapt ourselves at the Renfrew operation as it grows."

Until his latest move to Renfrew, he was in charge of the company's components department for home instruments in Montreal. Presently busy training personnel for the new plant, he is looking forward to his favorite recreation, curling.

Commending the company's training program, he recapped the courses taken at company expense that augmented earlier technical education in Toronto.



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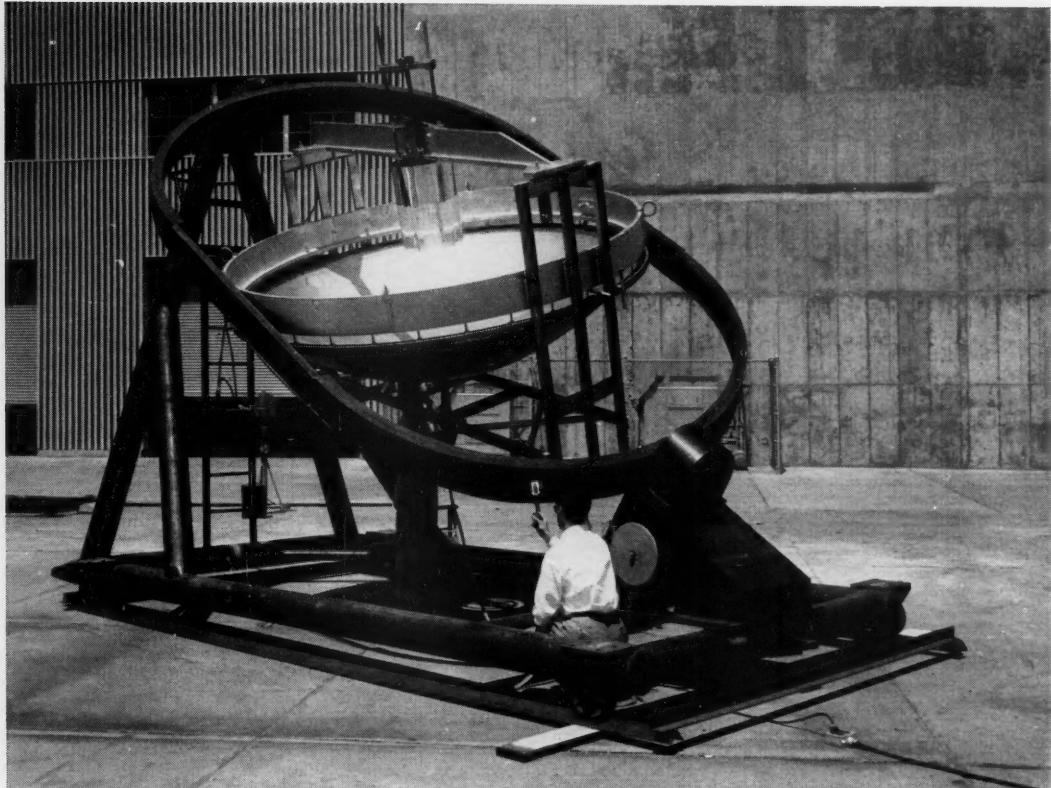
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See TV's top dramatic show Westinghouse "Studio One" Mondays at 10 P.M.

Design Engineering



Sun's rays are collected by giant aluminum mirror and reflected to a dime-size focal spot in Convair furnace.

Solar Furnace Aids Design Research

**A boon to the project engineer, solar furnace is science milestone
Developing a temperature of 8,500 degrees F. it melts steel in seconds**

HAVE YOU EVER LIT a cigarette, piece of paper or other object by focusing the sun's rays through a magnifying glass? This is basically the principle of the solar furnace which harnesses the energy of the sun and puts it to practical use.

Relatively efficient, the solar furnace converts upward of 70 per cent of the total incident radiation into useable heat. To date, temperatures above 7,000 degrees F have been obtained.

The solar furnace not only provides a readily controllable means of getting extremely high temperatures but it is also a useful tool for several scientific applications.

Its chief disadvantage lies in the fact that it produces heat only when the sun shines and requires a mechanism to keep it focused well on the sun. Another deterrent blocks popular use of the solar furnace since the cost is comparatively high.

Felix Trombe from the Centre National de la Recherche Scientifique in France constructed a furnace of practical design in 1946 with the assistance of the Paris and Meudon Observatories. In proceeding with experiments to use his furnaces effectively he used two war surplus German Army Zeiss searchlight mirrors. At the same time he devised a mount that permitted continuous melting of the pulverized substances at the focal points in the unit. Further support was given by the French Government in 1949 when they helped establish the Mont Louis Laboratory in an old fort in the French Pyrenees.

This led to the construction of a 35 ft. furnace with four small mirrors added to the existing two. At the Mont Louis site the climate was

Continued over page ➤

Solar furnace (Continued)



This 40-foot solar oven of Professor Trombe is located in French Pyrenees, generates temperature over 3000 C.



Saucer-like 40-ton solar oven in Algiers has 27½ ft parabolic reflector, creates temperatures 3000 deg C.

much improved over Meudon. Trombe was able to follow his earlier experiments with the continuous melting processes, centrifugal black body furnaces, and controlled atmospheres. This research established the solar furnace as an important experimental and industrial tool.

Trombe is presently using his furnace to produce refractory ceramics such as fused quartz and titanium oxide on a commercial basis. He is building four other, smaller, mirror type furnaces for further experiments.

Another solar furnace was built by a French firm, Sautter-Harle of Paris, near Algiers at Bouzareah for the Algerian Government research organization. The unit was designed by Professor Guillemonat of Mar-selles University.

It has a reflective surface with an outside diameter of 8.4 meters and an inside diameter of 1.83 meters. Five rows of reflective elements are made of specially shaped electropolished aluminum, installed with great accuracy on a moveable frame which tracks the sun. One surface of aluminum was used to make the reflective surface for this experimental furnace which is being used to synthesize nitric acid from air, water, chalk and sunshine.

Highest temperature recorded, Guillemonat reports, is not over 3,000 degrees C.

The cost of this furnace is about \$350,000 whereas the furnace on Mont Louis belonging to Trombe's experiments is said to be near \$60,000.

Another furnace, the largest in North America, is being used by Convair's San Diego Division in the study of various metals and ceramic materials for several research projects. Original design was by Dr. Willi M. Conn, and the furnace was used at an American college before Convair recently made the purchase.

A polished aluminum mirror, 10 ft in diameter forms a parabolic reflector. Made of one-quarter inch aluminum, the reflector draws its power from the sun's surface—a heat source of 10,000 degrees F.

Rays from the sun are collected by a huge mirror and reflected to a focal point. A five-sixteenths inch image of the sun is then formed 34 inches from the centre of the mirror. Metal jaws hold the materials being tested at the dime-size focal point.

In a matter of seconds the intense heat will melt a steel bolt. Under ideal sky conditions this furnace can develop a temperature of 8,500 degrees F, approximately 85 per cent of the temperature at the sun's surface. By comparison, the temperature produced by an acetylene torch is around 5,800 degrees F.

Scientists report several advantages in using this furnace for research. Heating, for instance, can be accomplished under very poor conditions and in an oxidizing temperature. There is no interference from electric or magnetic fields or gases which often happens when other type furnaces are used. Apart from these features to its credit, heat treating, melting or freezing of samples can be observed up to the highest temperatures. Moreover, very short times of heating and cooling are possible.

In the Convair furnace, the specimen holder is supported by a bridge structure which spans the mirror a short distance beyond the focal point. After part of the sample is melted, adjacent regions are moved into the focal spot by a motor driven screw. The bridge also supports a cylindrical barrel about 18 inches in diameter. This is used to shade some of the mirror from the specimen so that the amount of solar radiation can be controlled. A central opening 22 inches in diameter

Continued on page 56

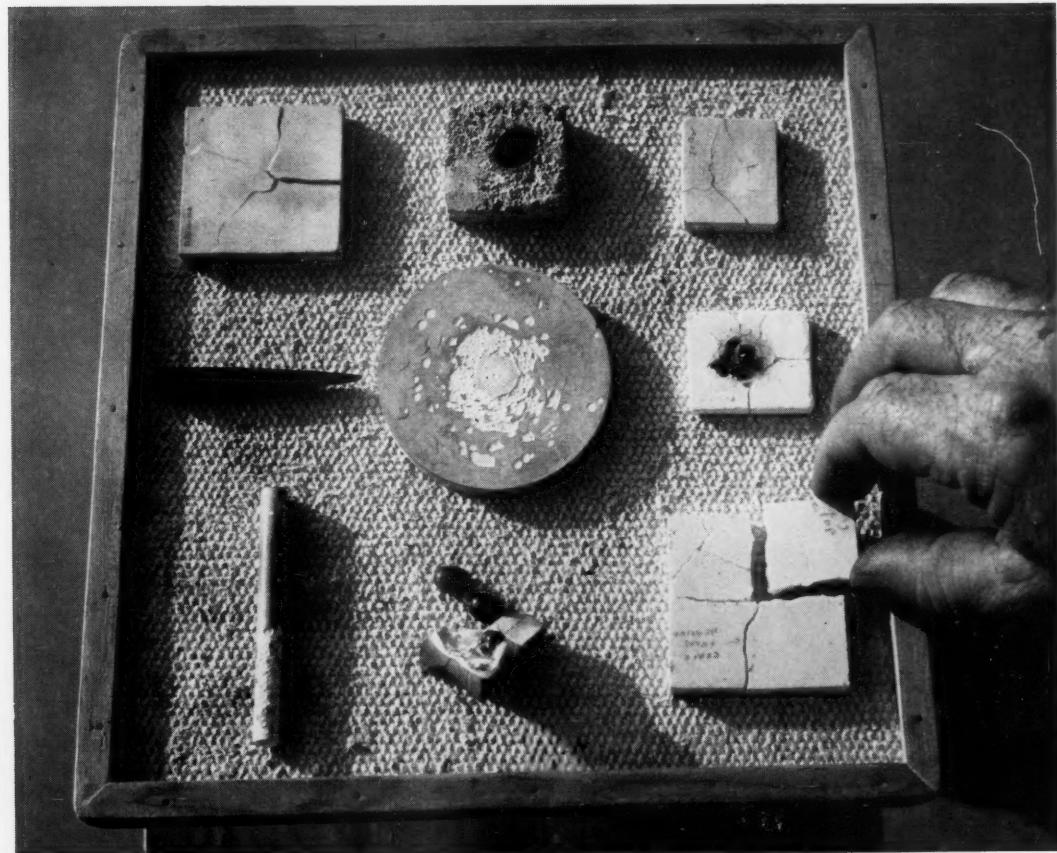


Ceramic material is shown as it begins to melt in the dime-size focal spot of furnace during an experiment.

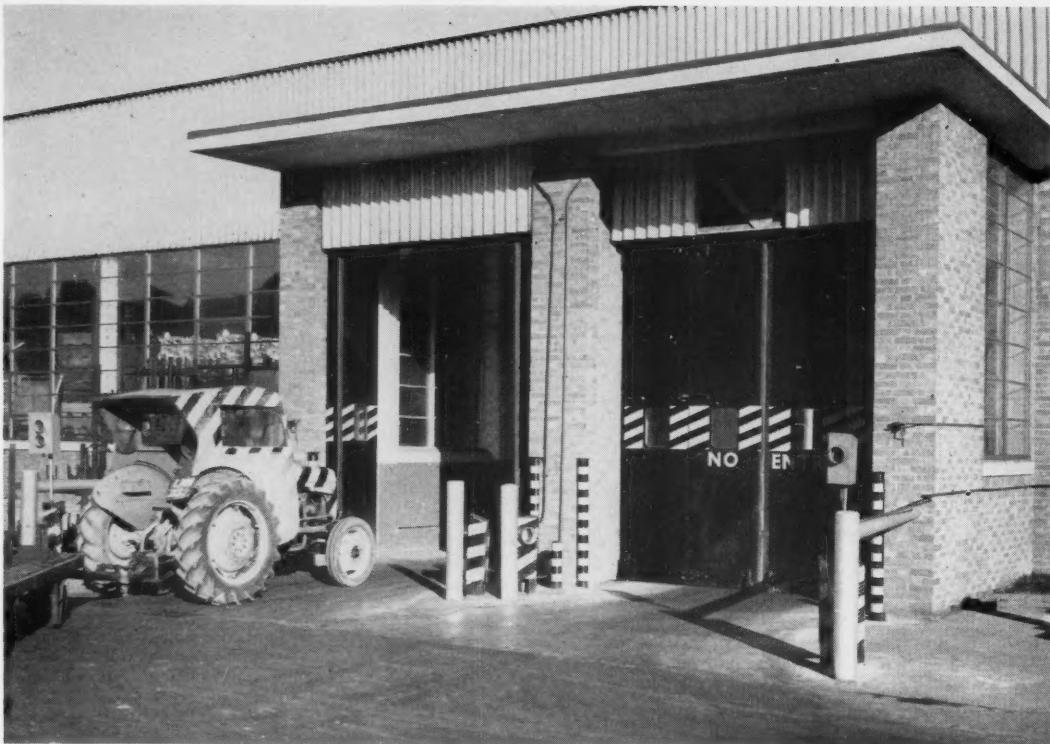


Engineer removes ceramic specimen after sun has burned a deep hole in the piece at Convair furnace, San Diego.

Engineers conduct tests with furnace into the heat properties of ceramics



This selection of ceramic materials has been tested in the solar furnace for relative melting points. Firebrick, top row centre, melted at 2030 deg C; boron nitride, bottom left, withstood heat to 3000 deg C.



Incoming vehicle enters through approach door. When tractor is in lock, door then closes, light turns red.

Light Rays Beat Problem of Draughts

British auto company employs them to cut heating, improve production

By J. A. OATES, A.M.I. PROD.E.

ONE OF THE MOST difficult problems facing the Plant Engineer of a large factory is that of maintaining a comfortable shop temperature in cold weather. This is particularly so in the case of buildings with large doors through which vehicles are constantly going in and out. Apart from other considerations, cold or draughty conditions are very bad from an economic viewpoint. They can cause serious loss of production through illness and discontent among the staff.

Vauxhall Motors Ltd. of England recently completed a detailed and scientific study of this problem at their Luton factory. The investigations occupied the best part of a year, and a variety of experiments was made before a successful, economic solution was found.

The way they achieved a solution can best be illustrated by considering the function of one large building devoted chiefly to major unit manufacture and assembly as well as the final assembly of commercial vehicles. Thus, in addition to a heavy flow of incoming and outgoing trucks carrying raw materials, parts and stores, through the various doors there is a constant stream

of assembled vehicles passing out of the largest door. The problem is made more difficult by the large volume of air extractions by certain of the processes in the building, which create considerable air currents. These processes also produce cold spots adjacent to the doors and openings due to the replacement air pulled in at extremely high velocity and low temperature. The building occupies 800,000 sq ft and has approximately 30 major door openings of various sizes up to 20 ft wide and 13 ft high, an area of more than 260 sq ft. A variety of solutions were looked into but all were either ineffective or uneconomic.

It was found that the provision of manually operated draught traps, when correctly operated, solved the problem of high-velocity cold air currents at doorways, but because of the excess door usage this scheme was impracticable. To operate it, two laborers would have to be employed at each draught trap and, in addition, the traffic would be slowed down considerably as the laborers became tired. This latter factor was considered important in a high production factory of this type because of the serious effect it could have on efficiency.

A study was then made of the feasibility of installing units above each door to blow hot air downward into the building. It was found that to raise the incoming air from 30 deg F to 65 deg F would require

more than 71 million Btu per hour. This figure was based on an allowance of 2 minutes for opening and closing normally operated doors, and one minute for mechanically operated doors. This scheme would have necessitated the installation of additional boiler plant and, in any case, would have been extremely costly to operate.

Experiments were then made by hanging large tarpaulins along the gangways facing the doorways: in addition, warm air blowers were placed above the doors. This scheme did not eliminate the draughts nor maintain the correct shop temperature. In addition, the tarpaulins were extremely unsightly and gave rise to dangerous fire hazards.

The difficulties involved, and the manner in which they were finally overcome can best be illustrated by a study of No. 18 door which, in effect, consists of two doors (A) and (B), as shown. Door B is used for incoming stores material, door pressings and underbodies. The adjacent door (A) is the exit for all assembled commercial vehicles. Originally the first door used approximately 48 times per hour, measured 10 ft wide by 13 ft high, whilst door A was 16 ft wide by 9 ft 6 in. high, and was used 15 times per hour.

The figures obtained from tests made on these doors illustrate in a very striking manner the problems encountered.

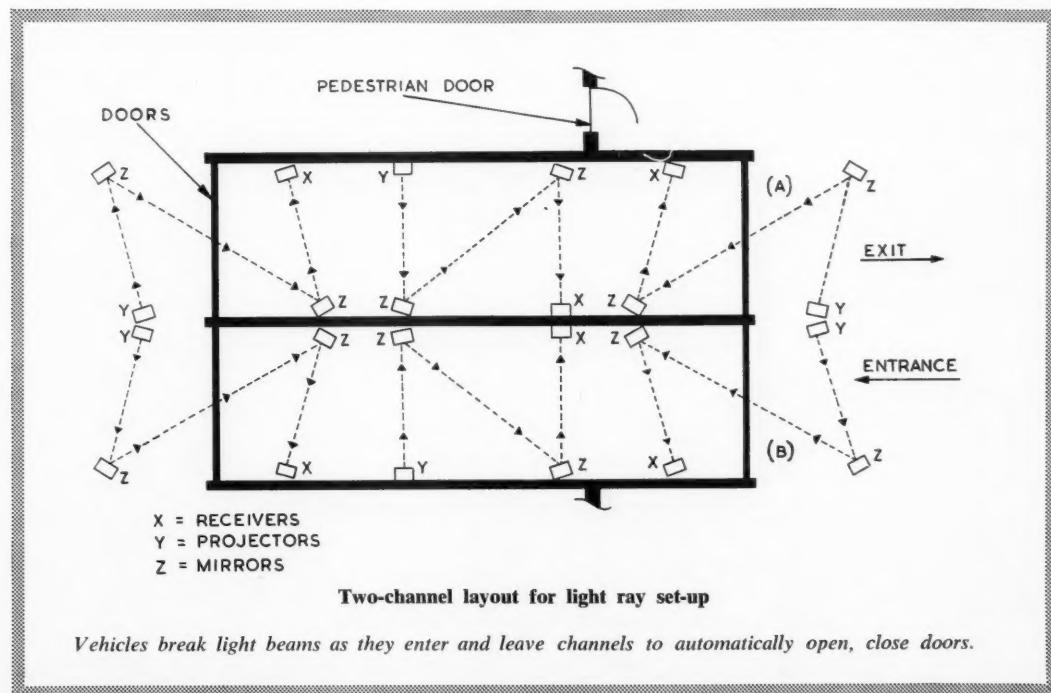
With both doors open the air velocity through them was found to be 650 ft per min, and the air intake in the region of 169,000 cu ft per minute. The air velocity adjacent to the operator nearest to the door (20 ft away) was 300 ft per min, which was the same as that at a point 40 ft outside the building: the air temperature was 51 deg F compared with 41 deg F outside the building. It was calculated that at the above air velocity and an outside temperature of 30 deg F, nearly 5½ million Btu per hour would be required to



Signal lights at entrance to door, upper left, are mounted above projectors, bottom, outside channel.

keep the shop temperature at the operator nearest to the door at 65 deg F. These tests were made at midday in January.

With only door (A) open the air velocity adjacent to the nearest operator was 360 ft per min and the shop temperature was 51 deg F: the velocity through the door aperture was 850 ft per minute. It is calculated that when this door was open nearly 1½ million Btu per hour would be necessary to maintain a shop temperature of 65 deg F. Even higher air veloci-



Light rays (Continued)

ties were encountered at some of the other doors in the block, in one case reaching 700 ft per minute.

The successful solution consisted of replacing the doors by an arrangement similar to that illustrated. This consists of two entirely separate vehicle channels, one for incoming and the other for outgoing traffic. Each channel is equipped with an "air lock" method of control which effectively ensures that both pairs of doors in either channel cannot be opened at the same time. This completely eliminated the entry of cold winds. The doors are actuated automatically by an electro-pneumatic door-closing mechanism controlled by special photo-electric equipment designed and supplied by Radiovisor Parent Limited. This is one of the biggest photo-electric controlled door-opening installations in the world and, also, the doors are some of the largest ever to be operated in this manner.

The layout of the No. 18 doors is shown in Fig. 1, from which it will be seen that adjacent to them is a small pedestrian door. The latter is self-closing, and avoids letting in large volumes of air each time a person enters or leaves the building.

The air lock for the vehicles is 47 ft long in this particular case, 13 ft of it being a brick-built entrance projecting from the side of the factory and supplied with windows (Fig. 3), the rest extending into the factory itself. A central wall divides it into two completely separate sections (A) and (B), each containing a pair of folding doors at both ends. Both entrances to the locks are clearly marked by bollards painted with distinctive black and yellow stripes.

Each lock has three sets of Radiovisor photo-electric equipment employing an ingenious Z-beam system arranged in the manner illustrated. In the case of the two outer sets of equipment in each air lock, the beam passes through a small hole cut half in each door, holes which are too small to affect temperature conditions. The beam from the projector falls on to a mirror on the opposite side of the lock which, in turn, reflects it back to another mirror on the other side of the door. Finally, this second mirror projects the beam on to a photoelectric receiver, thus completing the Z-shape path. A feature of particular interest is that the beam can be slanted in the vertical plane, thus giving coverage for vehicles of different heights. Each of the four doors has a traffic indicator which is either unlighted or shines amber or red according to circumstances.

The normal traffic arrangements are such that all outgoing vehicles pass through the exit door (A) and all incoming vehicles enter through the adjacent approach door (B). When the system is operating under these conditions the exit doors in both locks are closed and the approach doors remain open when the locks are not in use, that is, when no vehicles are passing through.

The approaching vehicle breaks the first light beam of the first unit—causing the amber light to show on the traffic indicator—and continues through the open door. It then breaks the first beam of the second photo-cell unit, at the same time clearing the last beam of the first unit. The combination causes the door to close behind the vehicle, and the traffic indicator to change to red, thus showing that a vehicle is in the lock. Should the vehicle stop however, thus keeping both rays broken, the door remains open until this

condition is altered. This prevents the chance of accidents which would occur if the door closed and a second vehicle attempted to enter, unaware (because of the amber light) that there was already a vehicle in the lock.

In the event of an unusually long vehicle or one with a trailer, entering the lock and keeping both beams broken—thus preventing the door from closing—the system is automatically cancelled. It is then necessary for the driver to press a wall-mounted push button which cancels the normal system and allows the second door to open. The vehicle then proceeds, and as soon as the tail clears the first beam, normal sequence operation is automatically restored. To draw the attention of the driver to the fact that the operation of the system has been upset, an alarm bell is provided.

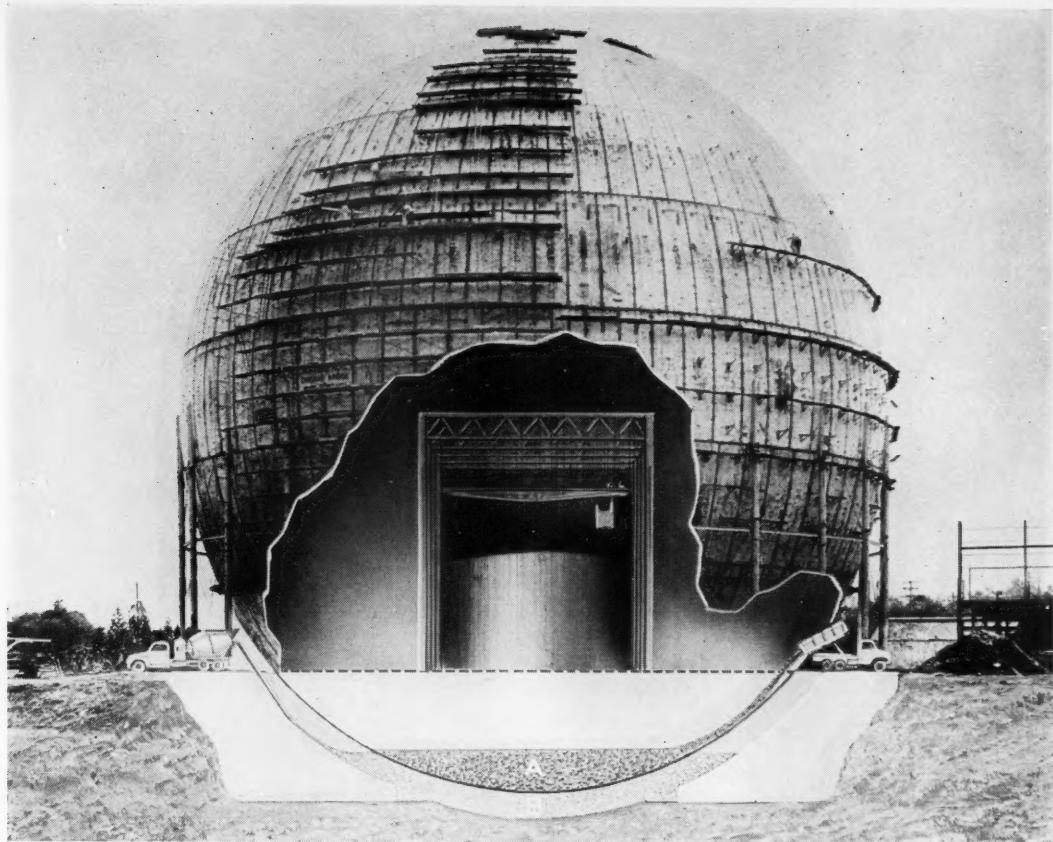
The closing of the first or approach door operates a limit switch which automatically permits the second, or exit, door to open as soon as the vehicle breaks the first ray of the third photo-electric unit. Then, when the last ray is cleared by the vehicle, the door automatically closes and, immediately afterward, the inner door opens again, and the lights of both traffic indicators go out. It is obvious then that at no time are both doors of either lock open simultaneously. Although the procedure may seem to be rather lengthy, the normal time for the passage of a vehicle is only a few seconds.

If one lock is blocked

In the event of an emergency, the locks may be used for traffic from either direction. This might be necessary if one lock were closed by a blockage, or for road repairs. In such an event, the single-approach photo-electric operation, change-over from one system to the other being made simply by movement of a switch. The air lock system is maintained. For this second type of system both pairs of doors in the lock are normally closed when no vehicles are passing through. Precautions to prevent the upsetting of the system by long vehicles are similar to those mentioned earlier.

A vehicle approaching the first door would break the first light beam, causing an amber light to show at the traffic indicator of this door, and a red light at the other door. The first door then opens and the vehicle proceeds, breaking the first light beam of the second unit, causing a red light to replace the amber light at the first light beam of the second unit, causing a red light to replace the amber light at the first door. The door now closes behind the vehicle, and a limit switch on it prepares the control circuit to make the second door ready for opening. Thus, as soon as the vehicle breaks the first ray of the third unit the second door opens automatically. The vehicle proceeds through the door, which then closes when the third beam remakes. When this happens, the two red lights are extinguished and the system is back to normal.

Most of the doors in this building employ the above dual-approach system, but in some cases modifications have been necessary to meet the special needs of local conditions. For instance, in one place there is a line of shop traffic at right angles to the entrance to an air lock, passing through the light beam controlling the doors. In this case the equipment is provided with a 3-second delay before the door opening system is energized. This is sufficient to allow any vehicles traveling along this lane to enter and clear the beam. ●



The atomic reactor for the sub "Sea Wolf" will be housed in this 20-story hollow steel sphere.

They Make a Test Bed For Atomic Subs

Taller than Niagara, this steel sphere will house an atomic reactor

RESEARCHING THE PROBLEM of driving submarines by atomic power has led to a \$3½ million hollow steel sphere built for the Atomic Energy Commission near Schenectady, N.Y.

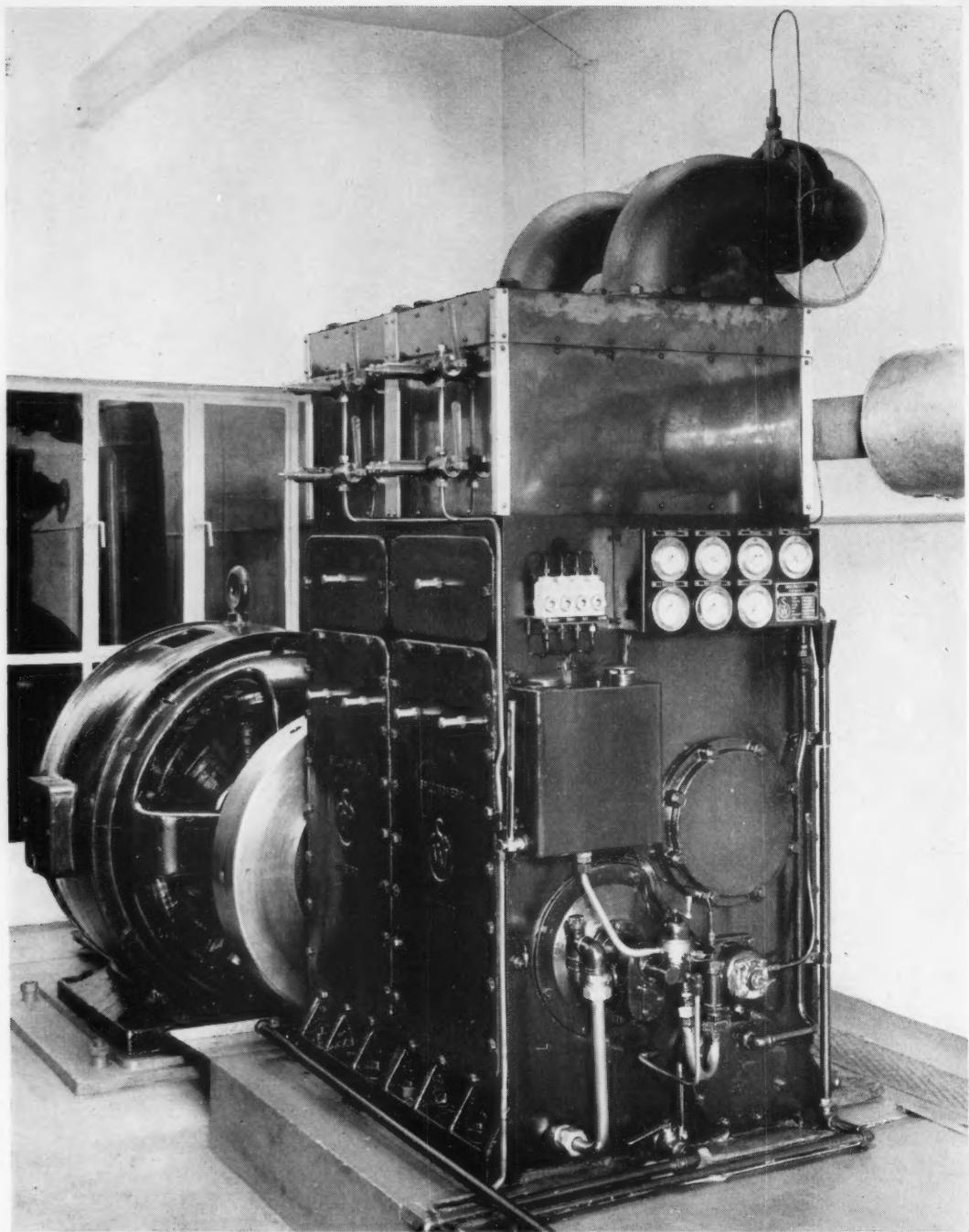
Designed to house the atomic reactor for the submarine "Sea Wolf," the sphere is now nearly complete.

Built by the Rust Engineering Co., the project is called SIR Mark A and is the land-based prototype of the Submarine Intermediate Reactor. The project is under the direction of the Knolls Atomic Power Laboratory at Schenectady, operated for the AEC by the General Electric Company.

It is one of two approaches being made to drive subs by atomic energy. The other reactor, the STR, or Submarine Thermal Reactor, is now under test at Arco, Idaho. In this project neutrons are used which are slower than the intermediate ones in the SIR reactor. A prototype of the nuclear engine in the world's first atomic sub, the Nautilus, is housed at Arco.

Near Schenectady, resting like an egg in a cup, the giant 20-story sphere nestles on its foundation some 38 ft. below ground level. It weighs 3,850 tons and is filled with 28,000 tons of crushed limestone which provides ballast. Originally the huge ball "floated" about four feet above its concrete saucer foundation, which was poured on alternate days to the limestone so that on no occasion did one material rise more than 18 in. above the level of the other. Now, a 3,900 cu. yd. cushion of concrete lies beneath the hollow ball. In the entire operation the utmost care was necessary to avoid setting up stresses that might break the one-inch skin of the ball or distort its shape. It was also imperative at one stage to support the sphere because each weld had to be X-rayed and given a final leak test for pressure. Engineers did this by supporting the equator of the sphere with a ring of 26 steel columns. Filled, the weight is distributed between the foundation and the columns. To pour concrete evenly in the buildup of the foundation, a chute revolved around the globe's axis.

(Continued on page 70)

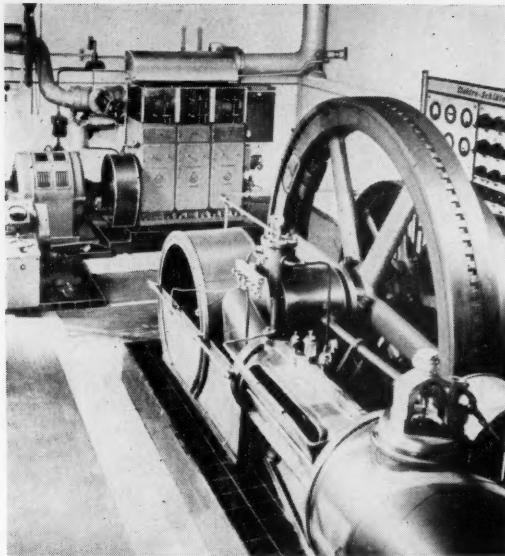


Existing steam engine, above, can be converted to engine that delivers additional hp during week-end shutdown.

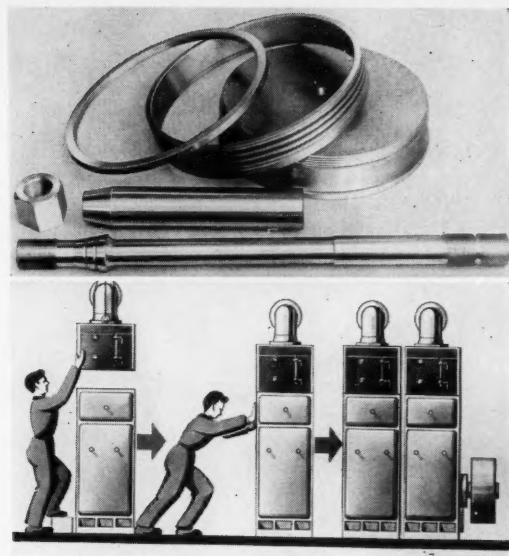
Put between existing units, the steam-motor adds 100 hp to engine output

With new diesel-like construction, units are interchangeable, adaptable

German Ingenuity Effects a Week-end



Old type steam engine, foreground, is in sharp contrast to the modern Spilling units arranged for conversion.



New piston gland with telescoping pipes like trombone, top. Bottom, artist captures simplicity of conversion.

BY ROBERT GERWIN
OUR GERMAN CORRESPONDENT

IF THE OUTPUT of your steam engine no longer suits you, take a new cylinder unit, put it between the existing units, and your engine will have 100 hp more!

Here is a conversion that can be done between Friday and Monday. This simplicity has been worked into the construction of a new steam engine, a so-called steam motor, made by Spillingwerk of Hamburg, well-known in Germany since 1890 as manufacturers of steam engines. The method is made possible only by using several new principles of construction, partly borrowed from modern diesel engines.

Today, most steam engines are of individual construction, each being designed for a special purpose. The Spilling steam motor is most adaptable, for only three different power units are necessary for engines of all sizes:

Unit No. 1 with 25 to 35 hp at 1,500 rpm.

Unit No. 2 with 100 to 140 hp at 750 rpm.

Unit No. 3 with 120 to 165 hp at 1,000 rpm.

Up to six of these units can be built together to make one steam motor. This makes it possible to replace a whole unit (or parts of it) in case of damage. The interchangeability shortens repair time, and allows the work to be done by untrained men.

But it is necessary to change the crankshaft when the motor grows up. And the eccentric shaft of the motor operating the sliding valves of the steam supply does not consist of a single part. Each cylinder unit has its own shaft and all shafts are connected together.

The crankshaft and the eccentric shaft rotate in a different sense and are balanced with special damper weights. This is to reduce vibration. The Spilling motor can be installed on unfavorable foundations as, for instance, in rooms over cellars.

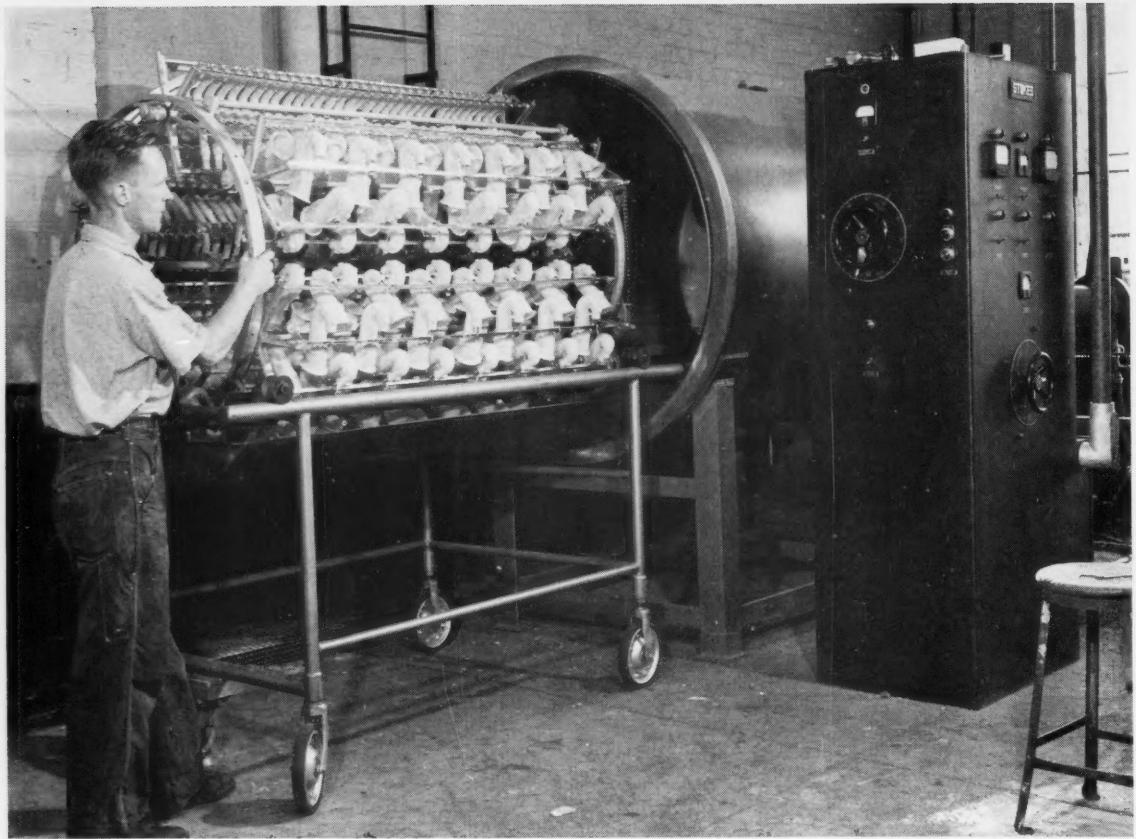
The cylinders are arranged vertically. Yet they are completely enclosed. This is made possible by a "heat-mirror," one of the seven new ideas which have been patented by the designer of the motor. The mirror consists of a simple water-layer between steam cylinder and crankshaft box. Since at normal air pressure water cannot be heated over 212 deg F, the bottom it covers cannot have more than about 210 deg F. The heat mirror easily blocks more than 500 deg F.

Another trouble common to vertically arranged cylinders, the risk that water-condensate may run into the lubrication oil (with the result that the oil is saponified) has been remembered. To prevent this, Spilling invented an entirely new piston-rod gland. It consists of two telescoping pipes, which are pushed one into the other like the sliding section of a trombone. The water condensated in the cylinder runs down the two pipes without reaching the central piston rod.

All parts are constructed so that they can be replaced without difficulty and without waste of time. For instance, the piston head is attached to the piston rod with only one screw. The cylinder liner, too, can easily be replaced. Its construction was based on modern internal combustion engine design. In spite of this and the high speed of rotation, the average speed of a piston is not very high, for the piston stroke is quite short. The speed of the piston is no higher than in an old-fashioned steam engine—about 11 to 13 fps. Although in modern diesel engines, piston speeds of 24 to 36 fps are normal, such a low velocity has been chosen to reduce wear.

The Spilling steam motor is especially suitable for outputs up to 1,000 hp. Up to such powers the efficiency is higher than for steam turbines. Moreover, the efficiency is extremely high in factories using steam as for example, in chemical plants and laundries. ★

Engine Conversion



Plastic saxophone bells are rolled into Stokes 48-inch vacuum metallizer at Harmonic Reed's Penn. factory.

Once just a decorative finish for toys, vacuum metallizing outgrows novelty stage

Vacuum Metallizing Battles Abrasion

BY J. GORDON SEITER

F. J. STOKES MACHINE COMPANY

UNTIL A YEAR or two ago, vacuum metallizing—the process of applying a thin metal coating to the surface of any base material by evaporation and condensation in a vacuum—was generally regarded only as a means of obtaining an inexpensive decorative finish in applications where not too great wear-resistance was required—such as plastic toys, costume jewelry and novelties like Christmas tree ornaments.

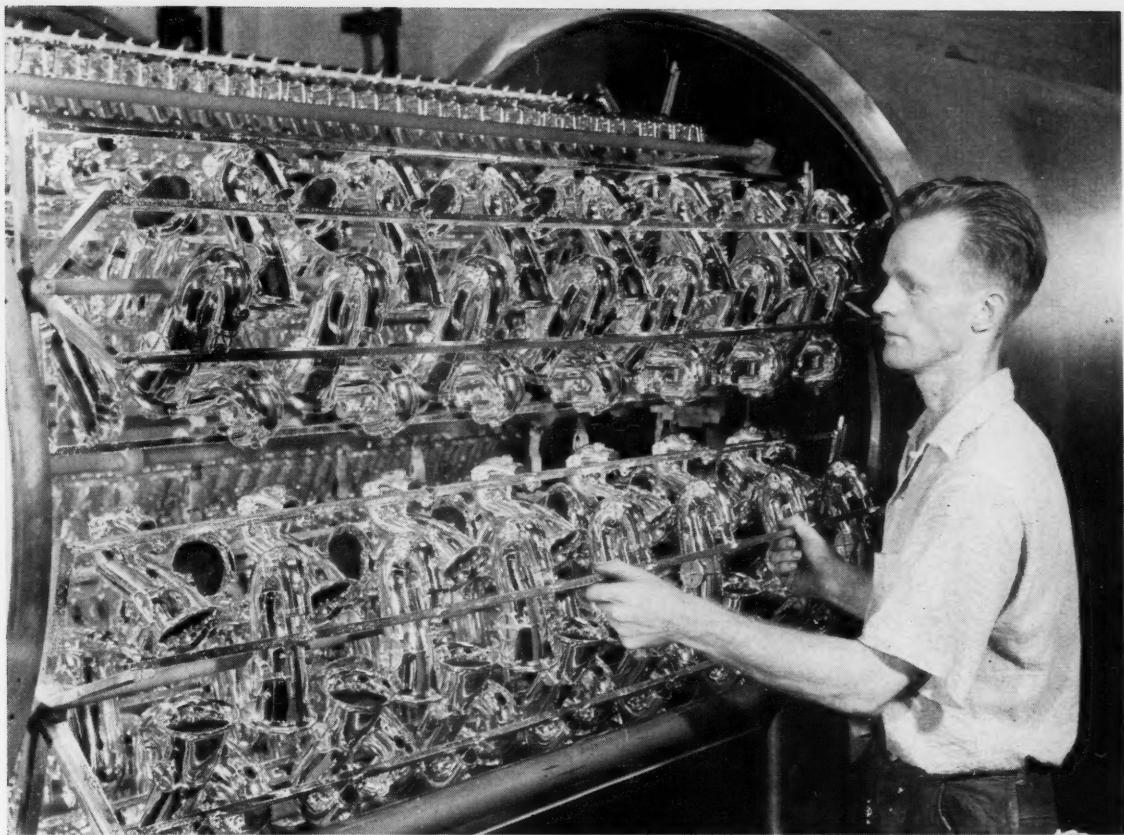
Today, however, thanks to the development of new and more durable lacquers for protecting the vacuum-plated finish, the process is being applied to a steadily growing number of products where good abrasion resistance is called for—such as automotive hardware, drawer pulls and plumbing fixtures. Recently developed synthetic resins and epoxy lacquers provide tough, durable, coverings which will withstand as much as 500

hours exposure to salt spray and 1,000 hours of humidity, without any sign of deterioration. And the automotive industry has recently done a series of tests which showed that a standard Taber abraser, with a CS-10 wheel and a 500 gm weight, will wear through copper-chrome plating before it will wear through a vacuum metallized film that has been properly protected with one of the new synthetic resins.

These developments, plus the tremendous cost savings that can be realized by the use of the process, have brought vacuum metallizing out of the "novelty" stage. It is now an established industrial finishing technique, and many new applications for it are being developed every day.

Such automotive items as dome lights, door handles, dashboard and instrument panel trim, under-window panels, scuff plates on doors, tail-light and parking-light reflectors, and molding strips are either already in production or on the verge of being produced in quantity by vacuum metallizing.

Domestic hardware such as drawer pulls and knobs for furniture and kitchen cabinets, push plates for



Result of depositing thin aluminum coat by evaporation under vacuum, parts emerge shiny in less than half hour.

as new and more durable lacquers protect its finish on thousands of products

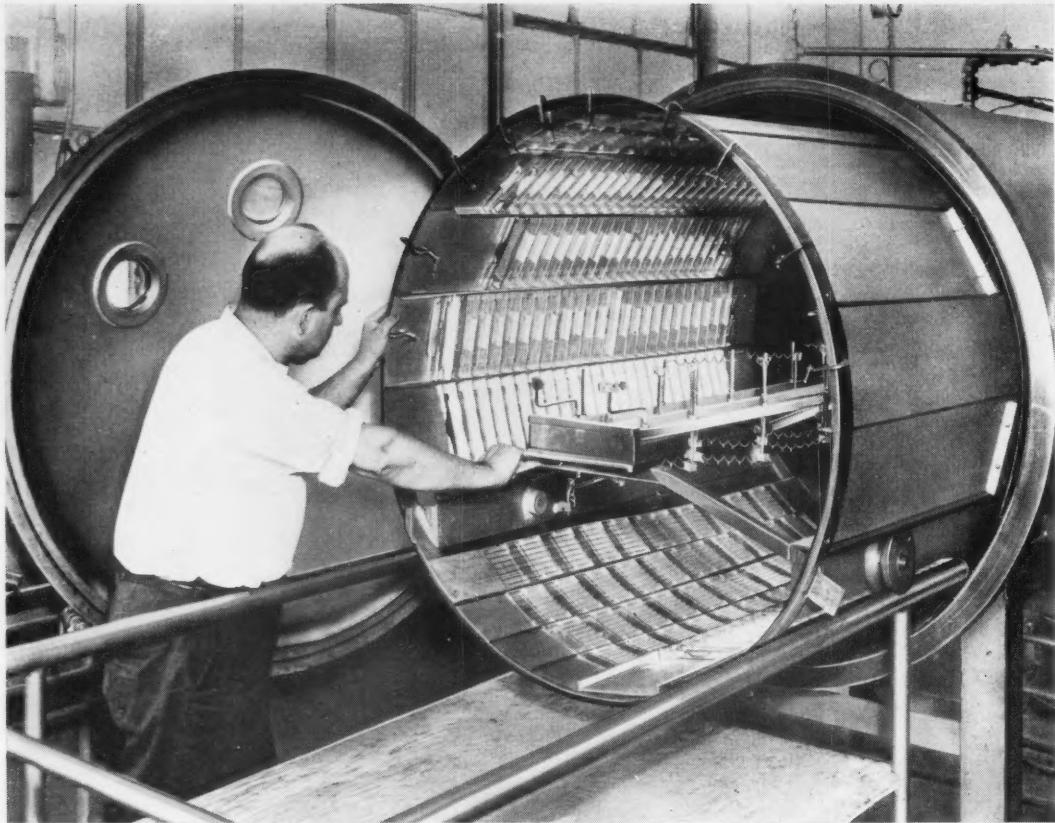
swinging doors, and knobs, grilles and trim for radio and TV sets are among the common household items now being finished by vacuum metallizing. In a test recently conducted by a large hardware manufacturer, it was found that a vacuum-metallized door knob, which was placed on one side of a much-used entrance to the factory, outlasted the conventional brass-plated knob on the other side. A counter on the door showed that after a period of 150,000 openings, the vacuum-metallized knob was in excellent condition while the brass-plated knob showed signs of wear through to the base metal.

The lamp industry has recently discovered the possibilities of this process for producing at low cost highly polished finishes simulating brass and chrome-plating. Such parts can be vacuum metallized for a fraction of the cost of the polished electroplated pieces formerly in demand.

Appliances are another field where the potential applications for vacuum metallizing are tremendous. Vacuum cleaner parts, for example, are being successfully metallized by this process, an application made possible by the development of synthetic resins for more durable protective coatings. The 1955 line of Kelvinator refrigerators uses vacuum metallizing in making the doors to cheese and butter compartments, as well as nameplates and "helmeted knight" medallions.



Big difference! Toy saxophone (left) was all-plastic, new brass-colored vacuum metallized sax is at right.



Nickel plated aluminum plates inside stainless steel drum are used to make selenium rectifiers for Westinghouse.

Vacuum metallizing (Continued)

In industrial components, the range of applications is virtually limitless.

In electrical parts, vacuum-plated coatings can contribute conductance, shielding, resistance and other desirable properties. For example, quartz crystals can be vacuum-metallized with silver to permit the soldering of electrical leads to the crystals. A thin coating of aluminum can be deposited on condenser paper, and the latter then impregnated with oil or wax, to make capacitors. Such units are smaller than those made of paper and foil, and have the additional advantage of being self-sealing. Metallized silver coatings have also been used for mica capacitors.

The evaporation of pure selenium onto nickel-plated aluminum sheets provides a new method of fabricating selenium rectifiers which provides longer life, greater stability, and less reverse current. Westinghouse Electric Corporation uses several Stokes vacuum metallizers for this purpose at its Motor and Control Division in Buffalo, N.Y.

Television picture-tubes can be made to give a picture that is nearly twice as bright by vacuum-aluminizing the rear surface of the screen, behind the coating of luminescent phosphors. This produces, in effect, a mirror which reflects toward the viewer the light from the glowing phosphors which would otherwise be lost

within the tube. This coating is especially necessary in color-TV tubes. RCA has installed at its tube-making plant in Marion, Indiana, special equipment for aluminizing these picture tubes on a continuous, almost completely automatic basis, with a capacity of 120 tubes an hour, for black-and-white tubes.

Non-conductive surfaces can be vacuum-plated with a thin layer of copper which can be used as the base for subsequent electroplating operations to build up a heavy layer of metal. This technique has been applied to the production of printed circuits and also of plastic printing mats, which have virtually the same printing quality as conventional electrolytes. Phonograph record "masters" are another application of this process, the wax pattern being metallized and then electroplated. The success of operations like this is due to the extreme thinness of the metal coating deposited and the absolute fidelity with which it reproduces the pattern of the original surface.

Vacuum coating techniques were first employed to provide low reflectivity coating on lenses and instrument covers and found widespread application during World War II. The pilots of a plane, for instance, would often see clouds and sky reflected in the glass covers of their instruments. It was found that a thin film of magnesium fluoride evaporated on the surface cut down this reflection and permitted full visibility of the instrument dials.

On the other hand, vacuum-metallized surfaces provide excellent reflectivity. Aluminum, evaporated onto glass, produces first-surface mirrors having exception-

ally accurate optical-quality reflectivity. For other products, too, such as flashlights, spotlights and space-lighting fixtures, vacuum-metallized reflecting surfaces provide new brilliance at an attractively low cost. Reflectors stamped from metal are now usually lacquered to give a smooth surface, and then vacuum-plated, at a cost much lower than for electroplating.

Perhaps one of the most familiar items produced by this process is the automobile horn button or medallion. These pieces are molded of clear acrylic plastic and are metallized on the rear or second surface so that the effect, when viewed from the front, is that of a three-dimensional metallic insert. Many novel and decorative effects can be obtained by this method. For example, a multi-colored metallized appearance can be given, by spraying translucent lacquers of several different colors onto the second surface of the molded plastic piece, prior to metallizing. These colors can be confined to certain limited areas by using metal masks during the spraying operation. The familiar Ford emblem, for instance, requires five separate masking-and-spraying operations before the piece is finally metallized. Each of the colors — black, red, blue, silver and gold—must be sprayed on individually and allowed to dry before the next color can be applied. Once the piece is fully lacquered, it is vacuum metallized with aluminum—also on the second surface—and the aluminum deposits give the multi-colored lacquered surfaces the strikingly effective metallic appearance which was desired. Where no colored lacquer was applied the aluminum appears as a chromium insert.

The majority of vacuum metallizing operations are carried out in batches, but by careful planning, with one rack-load of parts loaded to roll into the chamber as soon as the preceding batch is finished, virtually continuous operations are possible.

The process itself is basically very simple. The parts to be coated are mounted on suitable racks and placed in a vacuum chamber. This may be either horizontal or vertical, but the horizontal chamber seems to be preferred since it permits the load to be rolled in and out more easily. The chambers vary in size from 30 in. to 72 in. diameter and are usually 60 in. long.

The door to the chamber is closed and the cycle

started. The large capacity vacuum pumping systems with which these units are equipped make it possible to evacuate the chamber to the required pressure of 0.5 micron in from 7 to 20 minutes, depending on the nature of the products being finished.

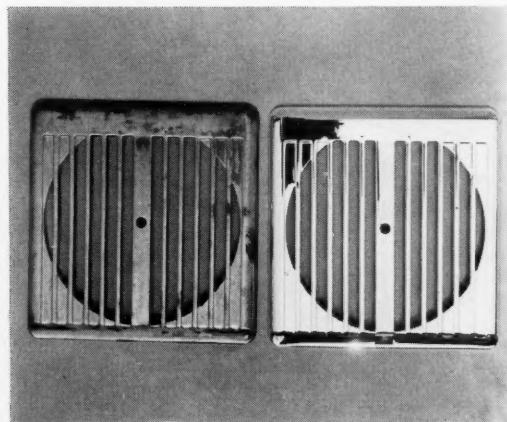
When the required pressure has been reached, the coating metal (usually aluminum) is melted and vaporized by resistance heating. As the metal vaporizes, the molecules take flight and travel through the vacuum at high speed until they strike and condense on the surfaces of the parts which are exposed to them.

Characteristically, these molecules travel only in straight lines. If a flat sheet were placed in the chamber with one side facing the vapor source, the side opposite the vapor source would not be coated unless the sheet was rotated during the time the metal was evaporating. This "one side coating" method is usually employed to metallize mirrors, reflectors, selenium rectifiers and automobile horn buttons and medallions.

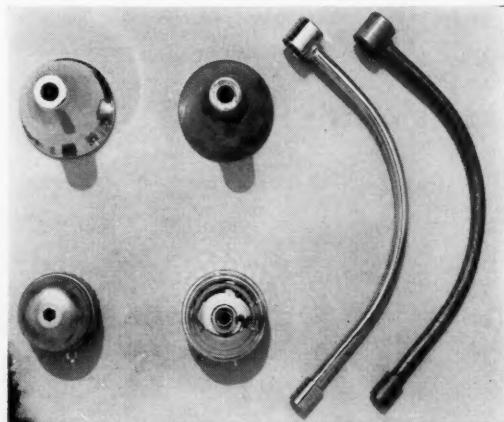
When it is necessary to coat all sides of the object, such as toys, jewelry and so on, the piece or pieces must be rotated within the vacuum chamber, just like a chicken on a barbecue spit. In this way, all surfaces are exposed to the vapor source and become completely coated. This rotation is achieved by means of a drive-shaft with a high vacuum rotary seal extending through the end of the chamber and driven by a motor which is mounted externally.

The metal usually deposited is aluminum, because it is the cheapest metal to use and it can be easily evaporated. Tungsten filaments, similar to the filaments in the conventional electric light bulb, although somewhat heavier, are used to hold small aluminum wire staples. This aluminum wire measures approximately 0.060 in. diameter, and the staples are about $\frac{1}{2}$ in. long. The staples are hung on the tungsten filaments, and when the proper vacuum has been obtained, current is passed through the filaments which glow to a white heat and cause the aluminum to melt and run up on to the filaments, wetting the entire surface. As the heat is further increased, the aluminum evaporates and coats all the parts within the chamber. The temperature of the filament at the evaporation point of aluminum is about 1800 deg. F. (Continued on page 52)

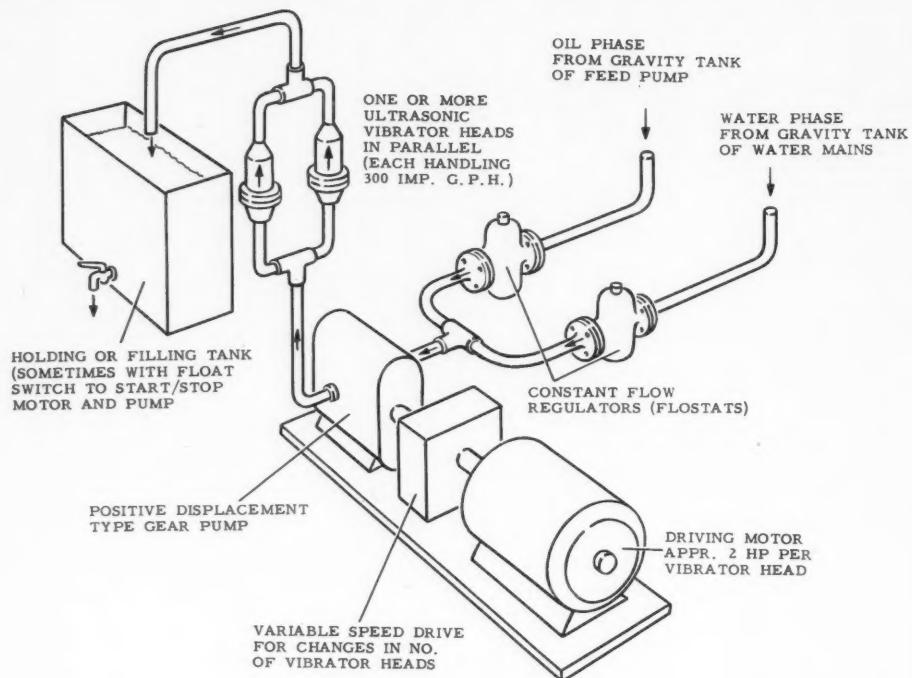
Mounted in racks, parts are placed in vacuum chamber for metallizing



Kitchen exhaust fan grille, a steel stamping, before and after the experimental vacuum metallizing process.



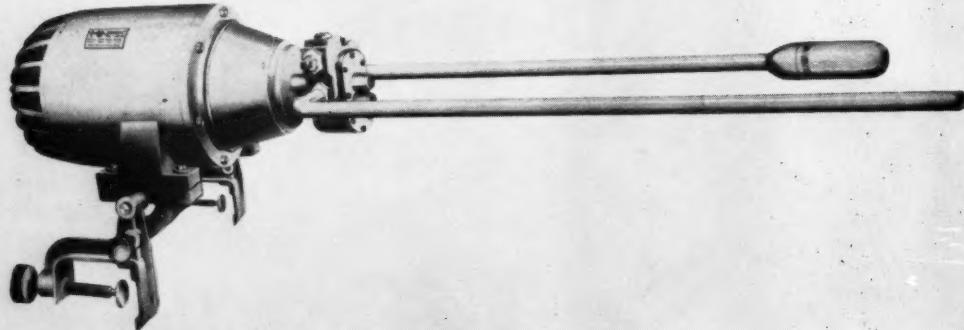
Bases made of steel stampings, stems of steel tubing, table lamp parts shown before, after vac-metallizing.



Simple arrangement of ultrasonic equipment features easy adjustments.

Homogenize and Mix Without Tears

Applied to cross-section of food, fluid chemicals, ultrasonics are simple



Typical ultrasonic homogenizer and emulsifier can handle 420gals. per hour, features fixing clamp for portability.

BY F. ROSE

INDUSTRIAL CONSULTANT

SING — AND YOU CREATE sound, which is energy in wave form representing fast alternating motion of the particles of the medium through which the sound travels. The frequency of these pulsating waves of energy is up to around 15,000 cycles a second. Run a siren with gradually increasing speed, and the sound frequency goes up, until somewhere between 16,000 and 20,000 cycles a second, the pitch reaches such a height, that the average human being ceases to hear it. This is where sonic—the application of audible sound—ends, and where ultrasonics—the application of inaudible sound—begins.

Certain animals, such as dogs, can hear higher frequencies, and special ultrasonic whistles, which are too high for our auditory senses to pick up, are perfectly audible to dogs and are being used by police and the armed forces, when they don't want an enemy of the public, or of the nation, to be warned in advance. Bats can hear even higher frequencies, up to 70,000 cycles a second, and, in place of eyesight, use the echo of their ultrasonic peeps, reflected from obstructions, as radar to prevent collision in pitch darkness.

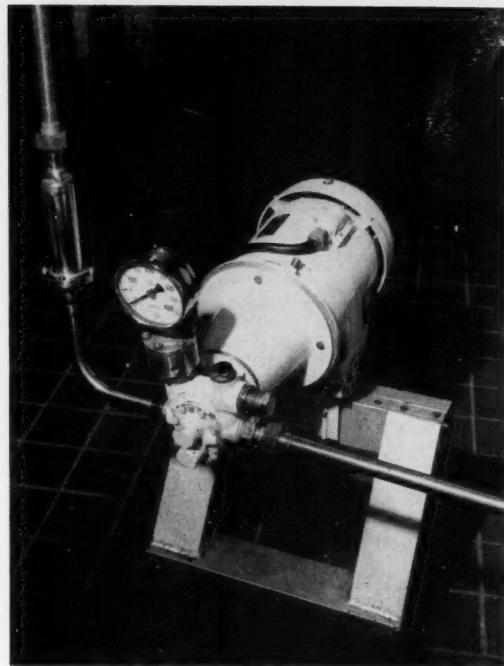
Ultrasonic waves can be produced either by piezoelectric, magnetostrictive, or mechanical means. It is the mechanical method which, because of its simplicity and low cost, is causing such a widespread interest in the processing industries.

The mechanical generator of ultrasound, now available to industry in a compact, easy-to-operate and inexpensive form, can best be described as a liquid whistle.

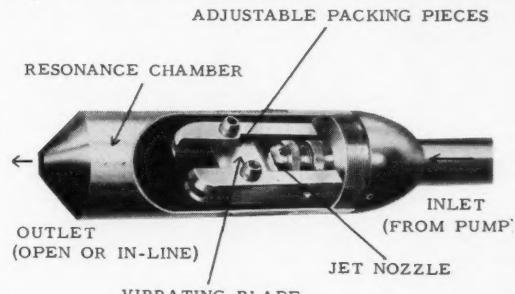
The ordinary policeman's whistle is an example of a sonic whistle. Imagine a similar device, but, instead of air, blow in a liquid. The liquid is "blown" into the whistle by a pump, developing some 200 psi pressure, and is allowed to rush over the sharp edge of a thin, easily flexing, stainless steel blade, which is only partly supported. The side with the sharp edge is thus able to vibrate in the liquid stream as this passes over and around it, exactly as the leaves of a book will begin to flutter or vibrate when you blow edgewise against them. This is the vibrating reed principle, used in musical instruments to produce audible sound.

The liquid emerges under pressure from a slit-shaped nozzle, in a flat jet, and the sharp edged blade, on which the jet impinges, is so clamped that it will vibrate at its own frequency, which is about 22,000 cycles a second, just a little above the upper audible limit which we can perceive. No detrimental effects of any kind are caused by these frequencies to the operator; the ultrasound produced is completely harmless.

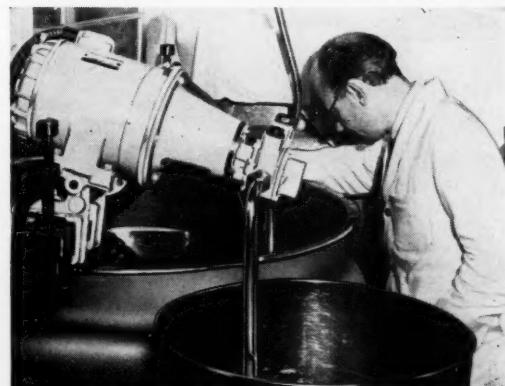
When liquid is subjected to ultrasound a phenomenon takes place known as cavitation. It is the rapid formation of cavities or tiny bubbles, which are filled with the vapor of the liquid and which collapse continuously, causing tremendous acceleration of the molecules, with resulting pressure of up to 30,000 psi localized in the immediate vicinity of the vibrating blade. This action can be compared with a continuous series of minute explosions of great destructive intensity within the liquid, resulting in its particles being broken up and finely divided into smaller sizes, down to one



In-line type ultramogenizer shows compact motor setup, pump and vibrator head. This standard unit is mounted on a wheeled stand for convenient use throughout plant.



Sectional view of the operating head of ultramogenizer shows the vibrating blade and high velocity jet nozzle. Both are adjustable inside a removable resonant bell.



For batch production this ultramogenizer is equipped with open discharge vibrator head, hidden in front vessel. Both pipes in vessel arranges re-circulation.

Ultrasonics (Continued)

micron (40 millionths of an inch). This produces intimate mixing of liquids which would normally separate, that is, it makes a stable emulsion out of oil and water. It also causes agglomerates, or clumped clusters of particles, to be broken up, and solids to be finely dispersed in liquids, so that they stay in suspension, instead of settling out at the bottom. In processing industries, such as food, cosmetics, pharmaceuticals, textile and other fluid chemicals, this effect can be utilized for homogenizing, emulsifying, dispersing and intimate mixing.

So much for the theory, which is simple enough. But the practice is simpler still. There is really much less to this device than the name suggests. No electronics, no intricate piping or wiring, no sensitive mechanism, requiring special skills or training for operation and upkeep.

The standard production unit, which handles 300-400 imperial gallons per hour (according to the viscosity) consists of a 2 hp totally enclosed, continuously rated electric motor, driving a high speed positive displacement type gear pump which develops up to 250 psi. The unit can handle even thick slurries and has an adjustable overload relief valve and full bore by-pass. For larger through-puts any required number of ultrasonic vibrator heads can be connected in parallel, each capable of handling 300 imperial gallons per hour, with a proportionate increase in the pump capacity

ferred for difficult emulsions of light viscosity, by placing both the inlet pipe and the outlet of the ultrasonic head in the same vessel. Additional mechanical stirring is advisable in this case, and the whole amount will eventually have passed through the ultrasonic head at least once, depending on the time recirculation is continued, the optimum period being a matter of experimentation for each individual product.

In all cases the output pressure of the pump, which determines the optimum velocity of the jet, is kept constant by checking with a suitable pressure gauge for which provision is made on the pump.

Let us take a look at a typical installation recently completed at a Toronto plant, where variegated ice-cream syrups, fountain toppings and ice-cream mix are now being satisfactorily "ultramogenized," a new verb in processing terminology. The pre-mix of the ice-cream syrups and toppings is made in the usual steam-jacketed kettles. When all ingredients have been added and the necessary amount of heating and pre-mix agitation has been applied, the outlet of the kettle is connected to the inlet of the ultrasonic homogenizer pump, and the outlet of the ultrasonic vibrator head is connected to the holding vessel, so that the ultrasonic unit becomes part of a continuous circuit. It will be seen that this machine will, apart from the actual homogenizing or dispersing action, also carry out its own material handling. That is, it will provide suction to obtain the raw material from the previous stage, and provide pressure to dispose of the finished product into the next stage, which is usually the final or filling stage.

For ice-cream mix the Ultramogenizer is connected to draw straight out of the pasteurizer and feed straight

Vibrating element consists of jet nozzle, sharp edged blade and housing

and motor horsepower. For abrasive or otherwise difficult liquids, slow speed gear pumps, or progressive cavity type pumps are used.

In the standard production model, the product is brought to the pump inlet under suction via a 1 in. rigid or flexible pipe (1½ in. for very viscous products, to reduce friction load). On the outlet side of the pump a short rigid 1 in. pipe feeds the product to the vibrator head in which the ultrasonic vibrations are generated by the rapid flow of the liquid edgewise over the blade.

The actual vibrating element consists of the jet nozzle, with its slit-shaped opening, and immediately opposite it, the sharp edged vibrating blade, all enclosed in an easily removable tubular housing, acting as protection and also as a resonance chamber for concentrating the vibrations and imparting them effectively to the liquid. In those units designed for open discharge of the ultrasonic vibrator head, it does not matter whether the head is submerged in the liquid or not, although submersion of the tip of the head avoids splashing which is undesirable, if the product has to be kept free from aeration. The equipment neither aerates nor heats the product, but smoothens it out into a uniform homogeneous consistency, free from lumps, and usually with a glossy sheen which lends extra appeal to many processed consumer products.

It is not necessary to prepare a pre-mix of the product to be emulsified. In a 2 phase system, all oil solubles can be added to the oil phase and all water solubles to the aqueous phase, and the oil phase can be drawn into the pump, separately from the aqueous phase, by means of a secondary pump inlet via a valve which is preset for the correct required ratio.

A third method is recirculation, sometimes pre-

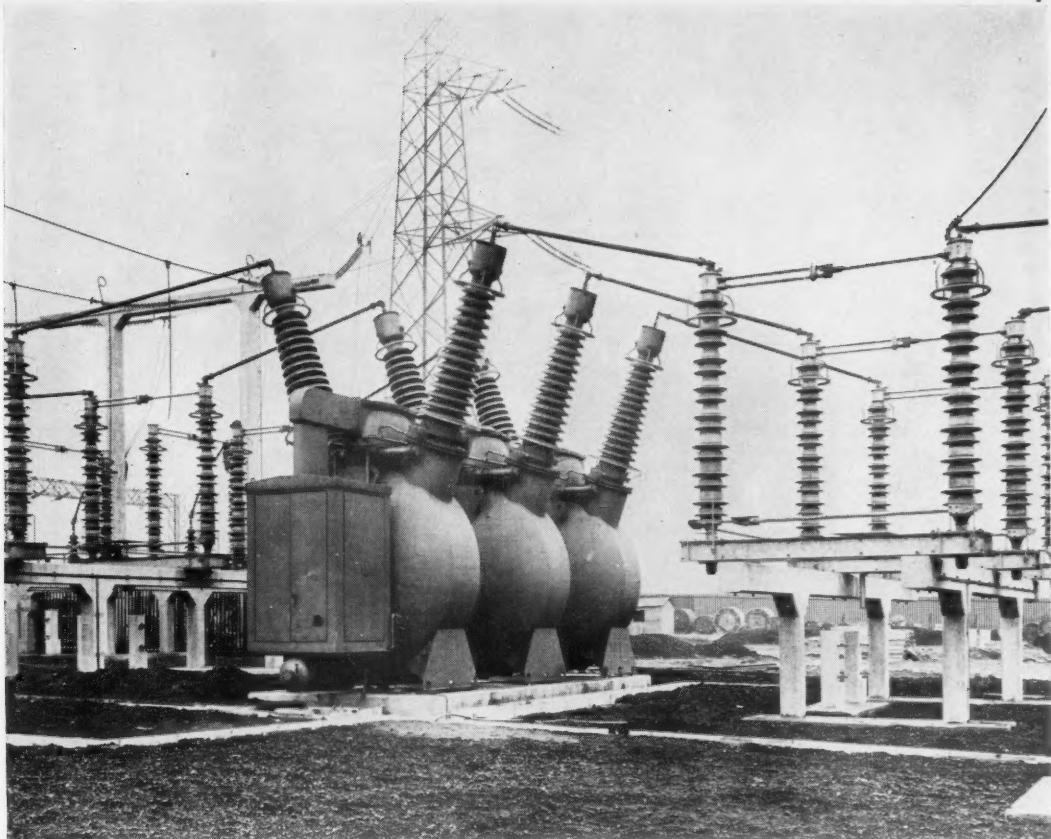
into the cooler. Independent tests have clearly shown that greater uniformity of particle size is achieved than with conventional homogenizers of either the single or the double stage type. No clumping occurs and the finished product is of a smooth texture, neither coarse nor gummy.

Fine variations in blade frequency are possible by a very simple and easy adjustment in the ultrasonic head, which takes less than two minutes and consists of varying the width of the unsupported part of the blade by moving the four packing pieces forward or backward. The tension of the relief valve spring can also be varied for any desired changes in output pressure. For most light viscosity products the best setting is that which leaves the maximum part of the blade unsupported and free to vibrate, giving highest amplitude, or lowest frequency, at a pump output pressure of 200 psi, observed from a pressure gauge.

It is of particular interest to processing plants, where absolute cleanliness is a first consideration, that all parts in contact with the product are sanitary and made of stainless steel. The unit is suitable for in-place-cleaning, but, if desired, the pump can be easily stripped down and cleaned separately in less than five minutes.

There are few plants that have an abundance of space available and it is noteworthy that the Ultramogenizer uses only about one-twelfth the space, and one-fifth the horsepower, of conventional homogenizers of equivalent output, and furthermore, it does not require water cooling, because it does not generate any frictional heat. The weight of the machine is 110

(Continued on page 67)



Resembling double convex lens or a lentil, these BTH breakers feature lenticular tanks, forming three-phase unit.

Quarter Million BC Order Boosts British Breaker World Export

**Phenomenal increase in power usage calls for high voltage transmissions
And successful switching equipment is ahead of even the greatest voltage**

AN ORDER FOR SIX, high voltage circuit-breakers, valued at more than $\frac{1}{4}$ million dollars, has recently been placed by the British Columbia Electric Company with the U. K. firm of British Thomson-Houston. The breakers are 230-kV, 7500-MVA, type JW 419, lenticular-tank, bulk-oil type fitted with resistance switching. Fifty such breakers have been put in service by BTH including the Canadian contract.

High voltage breakers have become more and more necessary during the past fifty years as consumption of electric power has steadily grown the world over. In 1900, the highest transmission voltage was 10,000 but today voltages up to 132,000 are common. And transmissions of 275,000 volts are coming into service.

Extensive testing and research by electrical engineers

in the problem of switching power at high voltages has resulted in the development of successful switching equipment at a pace ahead of the increased voltage in transmissions.

This engineering foresight by BTH is illustrated in the JW "Shuntarc" circuit-breaker. It is a logical development of the BTH range of high voltage breakers, specially designed to meet the exacting conditions peculiar to very high voltage transmission systems.

Operated by compressed air, the complete three-phase breaker consists of three identical single-pole units which are coupled together by operating rods and links to form a three-phase equipment. The lenticular tank, first introduced by BTH and followed in design by other companies, means a saving in oil up to 50



Self-contained lifting equipment is provided for the handling of bushings in erection. Davit and jib are shown during tests at Fontenay Testing Station, France, where new circuit-breaker proved self.

Circuit-breakers (Continued)

per cent compared to the cylindrical tank breaker of the same insulation level.

The Canadian units have four breaks per pole. For higher breaking capacity ratings this number is increased with the breaks being divided equally between the two terminals.

In the typical four-break arrangement, one break (the outer) is of the conventional pattern in which the moving contact is mounted directly on the crossbar. The other, however, incorporates a trapped moving contact which is normally held in the open position by the springs. It is pushed upward to engage with its fixed contact by an insulation striker rod. The striker rod is also mounted on the crossbar so that the two breaks, connected in series, are operated simultaneously. Simple design and robust construction of the BTH patented self-compensated arc-control chambers makes for trouble-free service and straightforward maintenance.

Each of the arc control chambers is shunted by a linear wire-wound resistor of pancake form, so arranged that current passes in opposite directions in adjacent coils which makes the unit substantially non-inductive. The whole assembly is under constant spring pressure within an insulating shield, the inter-space being flooded with oil when in the tank.

The resistor completely shunts the arc control chambers which are connected at the top to the casting in which the fixed contacts are fitted. At the bottom they are connected to resistor contacts in the throat or mouth of the arc control chamber.

The use of linear-type switching resistors makes the breakers suitable for use on any system irrespective of the restriking voltage severity.

Routine Maintenance Simple

Design engineers paid a great deal of attention to the avoidance of friction and reduced the inertia of the moving parts to the very minimum. Torsion bar springs have been incorporated to give high acceleration to the moving contacts. High tensile steel, light alloys and laminated wood have been used to the fullest extent to reduce weight without reducing mechanical strength.

These factors, combined with the efficient arc control system, result in a very high rate of contact separation and short opening times. When the breaker is operating the speed of the crossbar in the oil is of the order of 28 ft. per second, and the time between energizing the trip coil and the parting of the contacts is only 0.025 second.

The general layout of the breaker incorporates a number of features to ensure that routine maintenance can be carried out simply and in a short space of time. A large manhole is provided in each tank at a convenient height so that access can be gained to the inside of the tank from ground level. This feature obviates the need for ladders and derricks. Bulkhead light fittings are arranged inside the circuit breaker tanks and a fan is fitted to ensure the circulation of fresh air within the tank after the oil has been drained. An oil pump is provided to empty and replace the oil, a job it can do in ten minutes. Self-contained lifting

equipment is provided for handling the bushings on erection.

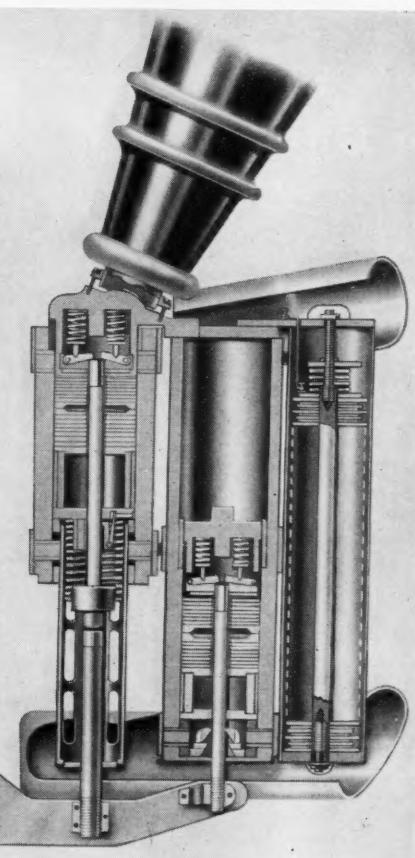
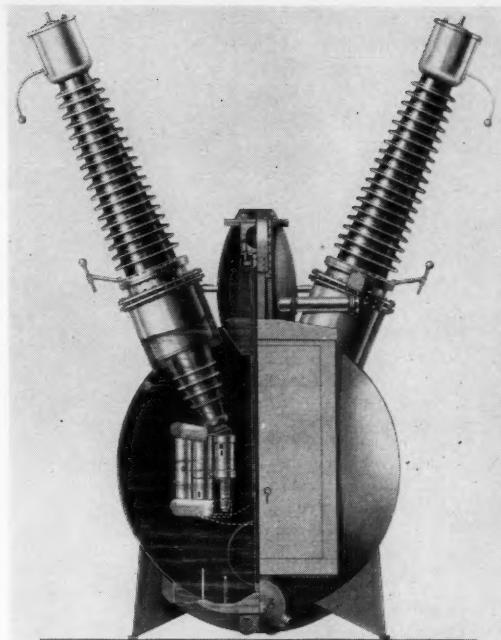
A comprehensive series of site tests to prove the circuit breaker's performance under service conditions at 220 kV was carried out at the Fontenay Testing Station of Electricité de France. The tests included line-dropping, the breaking of magnetizing and reactor currents, instantaneous auto-reclosing, and short circuit tests.

Over seventy line-dropping tests were successfully undertaken ranging from 27 to 620 km of line, the maximum over-voltage recorded being 1.67 times the peak line-to-ground voltage. Resistance switching superiority was fully demonstrated by these tests. Heavy oscillatory currents present when a line is energized without resistors were not experienced in any of the tests.

Tests to cover the clearing of transformer magnetizing currents were made under the worst conditions of no load with shunt reactors on the secondary side. During this series of tests the voltage did not exceed 1.64 times

(Continued on page 67)

Type JW breaker with cover off and on is shown, left. Note the shunt resistors, arc control chambers and the current transformers in one of three single-pole units.



Four-break arc control

One terminal of a typical four-break arrangement is shown in the above diagram. One break (on right) is the conventional pattern where the moving contact is mounted directly on the crossbar. Other has "trapped" contact.



Assembly of subminiature tubes calls for services of a binocular microscope, so fine is the tube construction.

Tiniest Tubes

Fit Close Confines With Design Space at Premium

By L. M. PRICE & J. R. WHYTE

CHIEF ENGINEER & PRODUCT ENGINEER: RADIO VALVE CO. LTD.

Subminiatures take big place in the tight space of the latest circuits

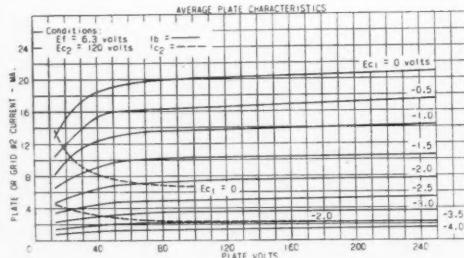
THE NEED FOR the subminiature tube resulted from a design requirement in applications where space was at a premium, where the tube must fit the circuit and not be the component which limited the equipment size. The term "subminiature" follows the present electronic equipment trend to miniaturization. A subminiature tube, as the name implies, is a small version of the conventional tube. The decrease in size has progressed in stages from the so-called "standard glass" tube of the 1920's, to the present subminiature tube.

The comparative sizes of the various tube glasses are given in table 1—

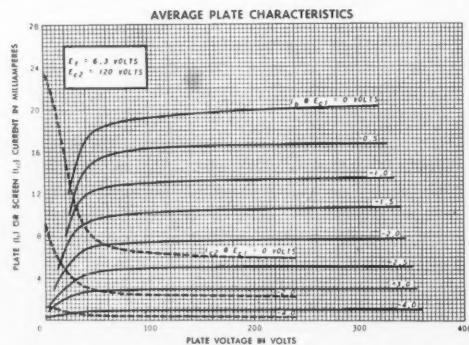
Table 1 Comparative Tube Sizes

	Diameter	Length	Volume
Standard Glass	1½ (in.)	4½ (in.)	8.0 cu. in.
GT	1⅛ "	3¼ "	3.2 cu. in.
Miniature	11/16 "	2 "	0.74 cu. in.
Subminiature	3/8 "	1½ "	0.17 cu. in.

Sub-miniature, miniature, performance graphs.



Both subminiature, above, and miniature have similar characteristics, performance differs.



Graph shows miniature tube to have better performance than midget at high voltages.

From these figures it is seen that the subminiature occupies only one quarter the space of a miniature, which is already a small tube; and the subminiature occupies only about one fiftieth of the space of the old "standard" tube.

The first subminiature application came from the size limitation of the hearing-aid. Small size was the first requirement, both to reduce the weight to be carried by the user and to make the hearing-aid inconspicuous. Along with the miniature tubes, other components were also reduced in size.

A really important application for the subminiature tube occurred during World War II when a tube was required for the proximity fuse. This device consumed tubes by the million and production figures by 1943 became enormous. The VT fuse was mounted in the nose of an anti-aircraft shell, and contained a transmitter, receiver and a firing circuit to explode the shell when it approached an airplane or similar object. The circuit contains several subminiature tubes. This tube is useful and necessary in limited space such as small devices for the commercial market and compact devices for the armed Services.

Operate same as large tubes

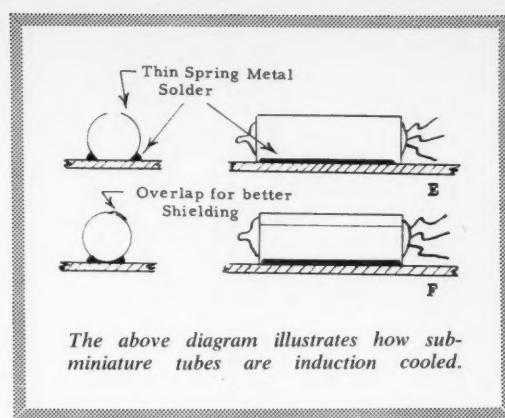
Subminiature tubes operate in the same way as the other large tubes they replace. The reduction in size has no effect on the essential characteristics of a tube. The equations for amplification factor and transconductance are independent of dimensions, and these two parameters, which determine how much amplification a tube will give, are not changed when all dimensions of a tube are reduced in proportion. In theory, a tube only needs to be large enough to contain the electrons which make it operate, but there are however, practical difficulties in reducing the size to such electronic dimensions.

The reduction in size has two beneficial effects on the electrical characteristics of the tube. The capacity between electrodes depends on their area divided by their separation. As dimensions are reduced, both of these features improve the high frequency operation of the subminiature tube as compared with larger tubes.

A reduction in size also brings an improvement in mechanical characteristics. If all the dimensions are cut to one half, the weight to be supported is cut to one eighth, as this weight depends on the volume of the part. The strength of the supports is only cut to one quarter, as strength depends on the cross-sectional area of the supports. Consequently, a small tube is much stronger than a large tube of the same general design.

A good example of the great strength of small objects is found in the mosquito. This insect has extremely small legs which are quite able to support its weight, even with an added burden of human blood. If the mosquito were increased to the size of an elephant, its legs would collapse, as its weight would increase more rapidly than the strength of its legs.

Another improved mechanical feature of the subminiature tube is its great rigidity. A small beam will deflect much less than a large beam under its own weight. Even the relative deflection of the small beam, compared with its own length, is less than the relative deflection of the large beam. This means that the small grids used in subminiature tubes will deflect a smaller fraction of the grid to cathode distance than



the larger grids used in larger tubes. Consequently the noise output of a small tube is less than a large tube when they are subjected to vibration or other shocks.

As a result of the decreased deflection of the small parts in a subminiature tube, the resonant frequencies of these parts are increased. This increase in resonant frequency is desirable, since most vibrations excite the tube at comparatively low frequencies. If the tube is resonant at these frequencies, the noise output will increase greatly. The small tube raises the resonant frequencies so that peaks in the noise output are less liable to occur.

To give a true picture, the disadvantage resulting from small size should be mentioned. The power that can be radiated from a tube depends on the size of the plate and bulb. As a result, small tubes are limited in power dissipation. Audio output tubes, which can be used to operate a loudspeaker, are available in the subminiature size, but the largest of these tubes is limited to an output power of one watt.

Another drawback of the limited power dissipation of the subminiature tube is found in the fact that the glass envelope is hotter than that of a larger tube, operating at the same power level. This problem is not too serious, as several conduction cooling methods have been developed by which the tube is firmly connected to a relatively large piece of metal which cools the tube by conduction. By this means the temperature of the bulb is reduced.

Usual electrode combinations

Subminiature tubes are available in all the usual electrode combinations—diodes, triodes, tetrodes, pentodes and beam tubes. The larger structures, such as double triodes and double tetrodes, have been compressed, with some ingenuity, into the subminiature bulb and several types of these tubes are made.

Gas tubes, as well as high vacuum tubes, are made in this small size, such as voltage regulators and even a tetrode thyratron. Some of these tubes have the same electrical characteristics as the corresponding tube in the larger bulb. Others have no exact equivalent.

Both indirectly heated cathodes and filamentary cathodes are found in subminiature tubes. The indirectly heated cathode types are constructed in a round

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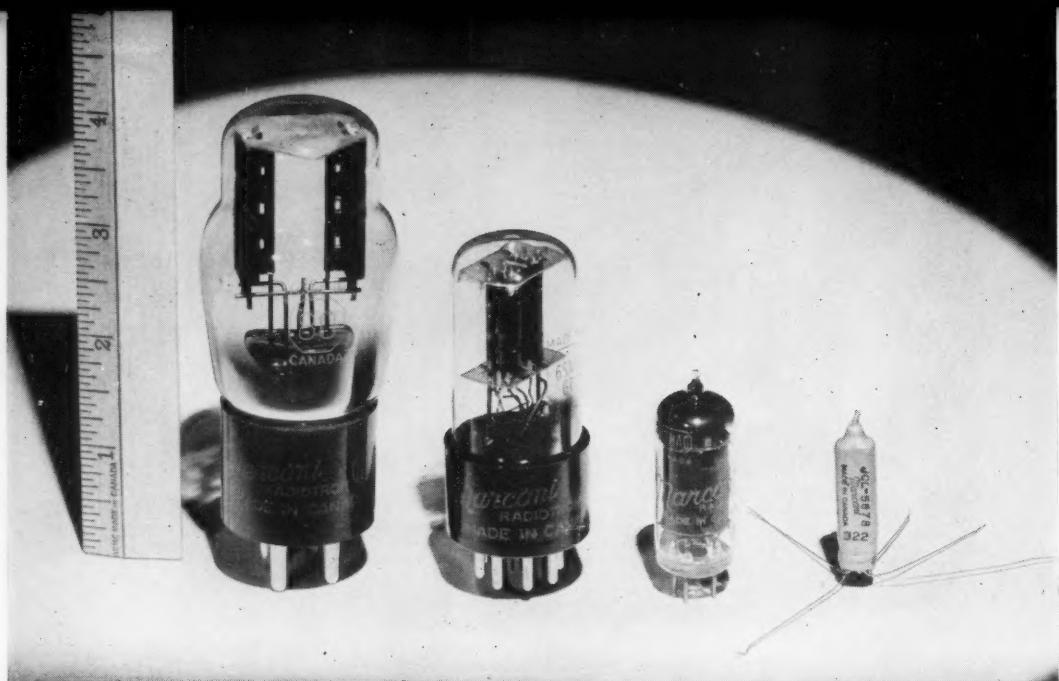


Illustration shows the comparative sizes of the standard glass miniature Marconi tubes and the subminiature tubes.

Subminiature Tubes *Continued*

bulb known as the T3, with a nominal diameter of $\frac{3}{8}$ inch. These subminiature tubes have eight flexible wire terminals arranged in a circle where they emerge from the glass stem. Most of the tubes with filamentary cathodes are in a flat bulb known as the T2X3, with a nominal size of 0.275 in. x 0.375 in. This shape of bulb has from five to seven leads arranged in a straight line where they emerge from the "press" of the bulb. There is little to choose between the two bulb shapes; the flat bulb is smaller and consequently occupies less space, but the round bulb has shorter and

more widely spaced leads, giving a tube which is more rugged and with less lead inductance.

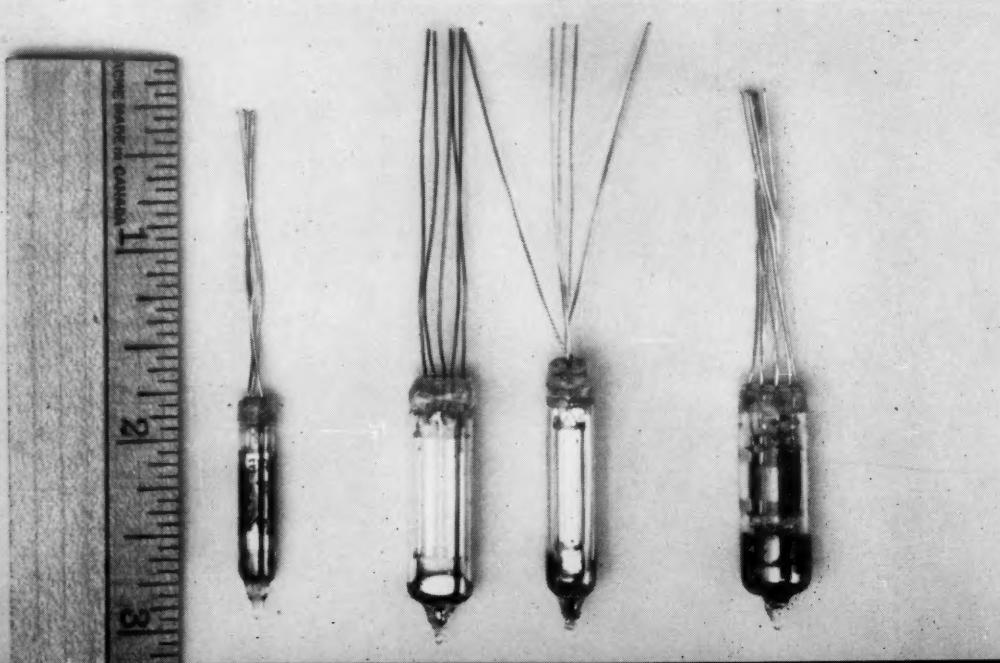
There are other subminiature tubes in smaller bulbs. One class is in a T1 bulb and another in a T2 bulb. These have a diameter of $\frac{1}{8}$ in. and $\frac{1}{4}$ in. respectively. The T1 version is only constructed as a diode.

Subminiature tubes may be installed in tube sockets when made with short, stiff terminal leads. These tubes are normally made with long flexible leads and soldered into position, making the tube an integral part of the equipment installation.

Most of the subminiature tubes with directly heated or filamentary cathodes are intended for hearing-aid operation. Since these devices are operated for a large portion of every day, battery drain is of

(Continued on page 70)

Below, an illustrative comparison of the T1 subminiature tube, right, with two views of T2, centre, and the T3.



Patents

Some new ideas win protection in Canada

THREE NEW YORK State inventors have patented a new die for high frequency sealing of plastic sheets. As described in Canadian Patent No. 514,470 issued July 12, 1955, the die has double sealing walls, with the outer wall adjustable vertically to make a groove in the plastic sheet that is deep enough to produce a clean-edged tear seal for any thickness of sheet. The inner wall makes a shallower groove and simultaneously seals and embosses the material a short distance away from the tear seal.

The inventors are John P. Gannon and William Schnitzer of Bronx and Jacob Paintner, of Hollis, New York.

GENERAL MOTORS CORP. of Detroit has taken out Canadian Patent No. 514,859 dated July 19, 1955 on a heavy duty bearing. It features a layer of aluminum or aluminum alloy that has a roughened surface coated with thinner layer of a soft bearing metal. The aluminum layer is bonded to a steel backing.

According to the patent, which names Jean A. Lignian of Dayton, Ohio, as the inventor, the roughened surface of the aluminum has minute grooves running transversely to the direction of location of the bearing, and the coating has a thickness within the range of a flash coating to .001 in., producing an undulating surface approximating the undulations of the grooves.

GERMANIUM SIGNAL translating devices are dealt with by Western Electric Company Patent No. 514,657, issued July 12, 1955. The patent describes a method of treating the surface of the germanium with a mixture of nitric and hydrofluoric acid, soaking the chemically polished surface in a solution of potassium cyanide and water, and then washing the surface.

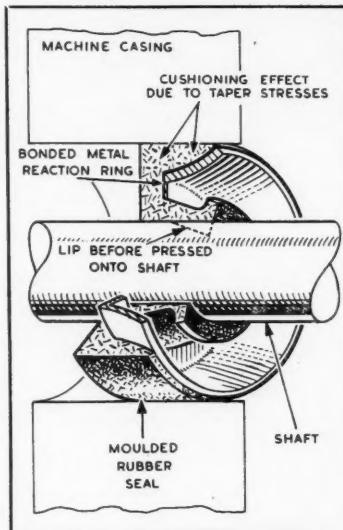
The inventors are Ralph A. Logan of Morristown, New Jersey, and Morgan Sparks of Basking Ridge, New Jersey.

A CORROSION-RESISTANT surface film for stainless steel is produced by a method patented by Armco Steel Corporation of Middletown, Ohio. As described in Canadian Patent No. 514,523 issued July 12, 1955, the method includes electro-lytically depositing substantial amounts

of lead peroxide or manganese dioxide on the surface of the steel.

The patent names John F. Kreml of Baltimore as the inventor and covers stainless steel articles made with the patented surface film.

PATENT NO. 514,852 issued on July 19 to The Garlock Packing Company of Canada, Limited of Toronto covers this new oil seal for machine shafting. It is



said to give a better cushioning effect than ordinary seals of this kind.

Invented by Edward W. Fisher and Albert M. Chambers of Palmyra, New York, the seal includes a tapered metal reaction ring that leaves a greater thickness of rubber between the ring and

the shaft bearing at one face of the seal than at the other. The result is good rigidity and an unusual degree of cushioning against vibration. On the shaft side of the seal, the sealing lip reacts resiliently against the shaft to give a good running seal.

A NUMBER of patents covering new alloys were issued to Johnson, Matthey & Company Limited July 26.

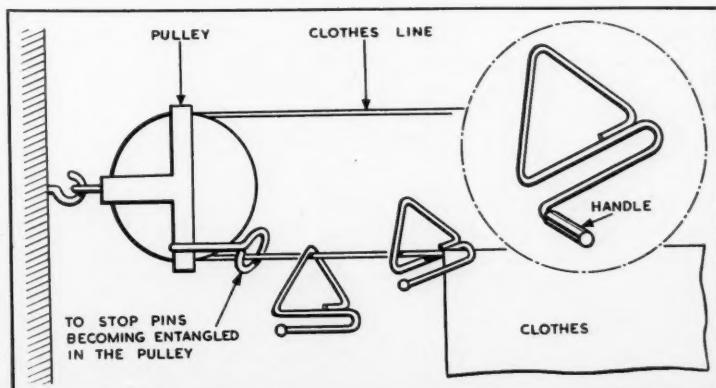
High resistance to creep and freedom from oxidation—scaling at high temperatures are said to be advantages of one of the new alloys, covered by Patent No. 515,049. Invented by Alan R. Powell and Jack C. Chaston of London, it may contain from 5 to 40% chromium, from 5 to 25% of a mixture of tantalum and columbium and the balance mainly cobalt or cobalt and nickel.

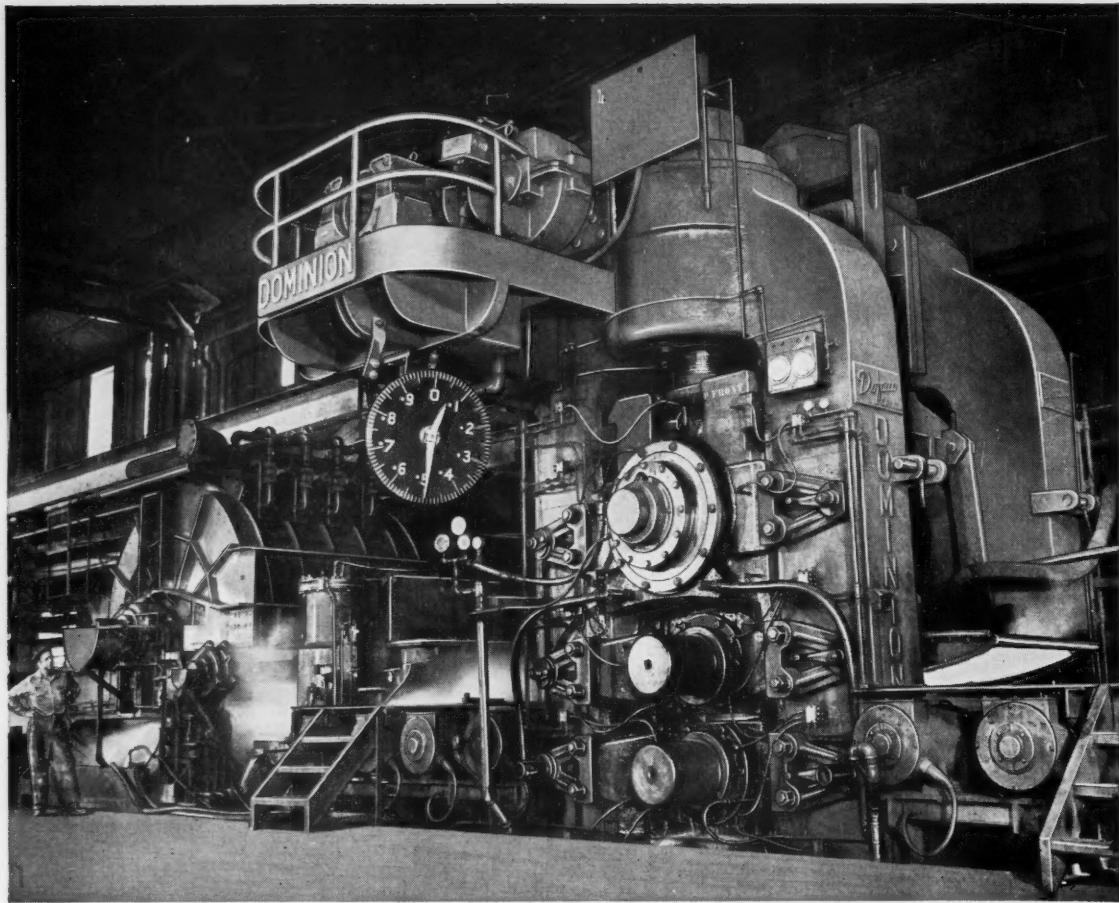
Jack C. Chaston is also the inventor of Patent No. 515,050, covering a new alloy of gold, silver, copper, zinc and beryllium.

A WRINKLE coating composition consisting of a mixture of polyvinyl butyral, butanol, and water invented by William A. Waldie of Dayton, Ohio, has been covered by Canadian patent No. 514,604 issued July 12, 1955.

SOMETHING NEW and different in clothes pins was patented on July 12, 1955, by the inventor, Henrick Wachsmann, of Montreal. Made of a single length of wire, as shown in the drawing, it is designed to remain permanently on the line. By lifting and tilting the triangular loop, the lower bar of the loop and the bend beneath it push against the clothesline on both sides, holding the clothes tightly. The handle on one side of the pin helps to raise and tilt it when hanging clothes.

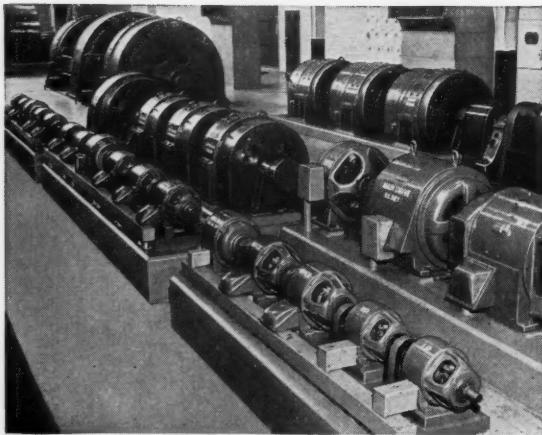
One advantage of the new pin is its ability to hold two drying articles at once. It is covered by Canadian Patent No. 514,509.



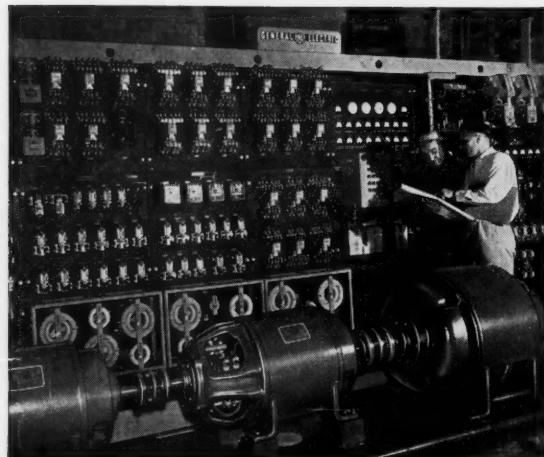


G-E Motors and Controls power and co-ordinate the operation of this new Reversing Hot Strip Mill at the Dominion Foundries and Steel Limited plant in Hamilton, Ontario. The new mill rolls hot strip and sheet steel with the highest level of uniform gauge and shape, at the rate of 1,800 feet per minute.

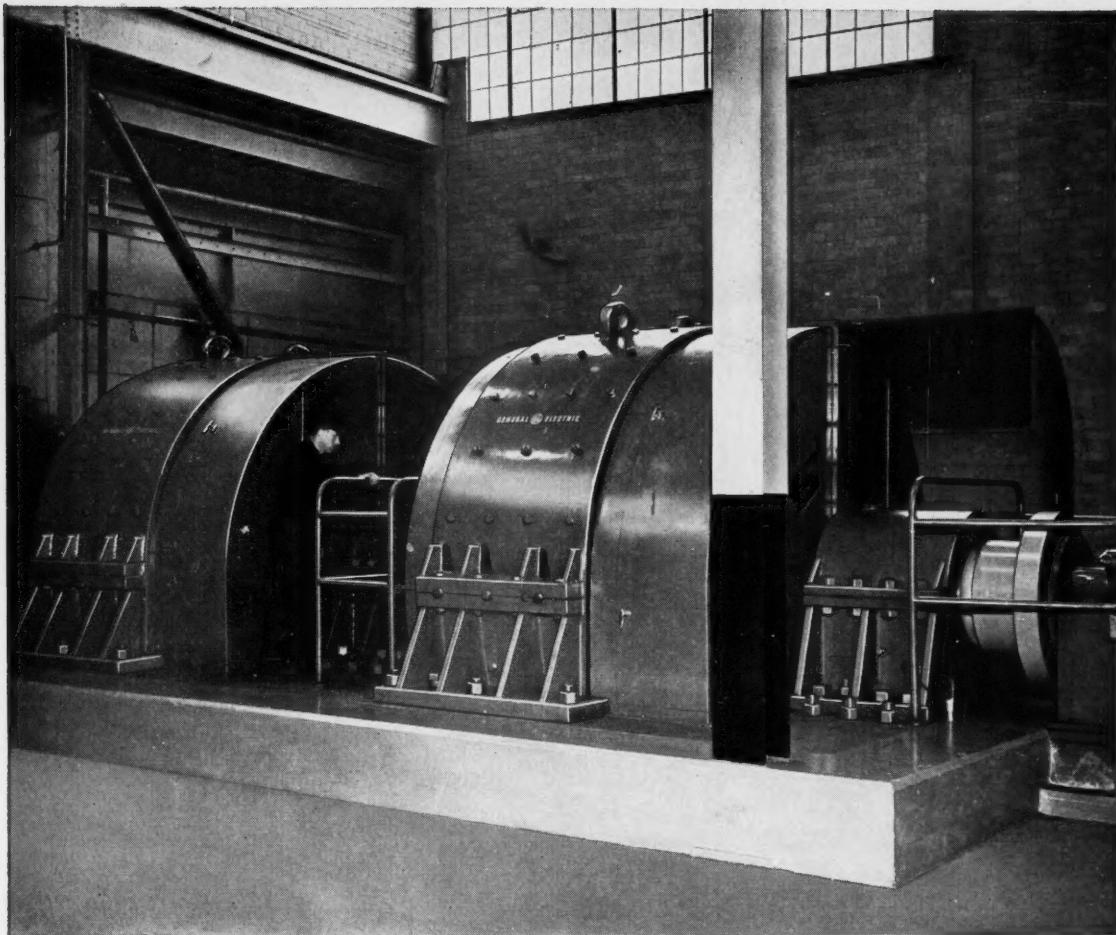
C-G-E Application Engineering Helps



A general view of the motor room showing some of the G-E motor and generator sets used to operate Dofasco's new Hot Strip Mill, in Hamilton, Ont.



Partial view of main DC Switchboard and Amplidyne sets gives some idea of the intricate control system engineered by C.G.E. to co-ordinate the operations of this new mill.



The mill is driven by two 3,000 HP G-E D.C. Mill Type Motors mounted in tandem. They are supplied by a motor generator set consisting of a 7,000 HP, 13,800 Volt, Synchronous Motor, driving two 2,500 KW G-E Generators. There is also a 2,000 HP auxiliary M.G. set.

DOFASCO Increase Production . . . Add Two New Products

With the completion of this multi-million dollar reversing Hot Strip Mill at Dominion Foundries and Steel Limited, Hamilton, C-G-E Application Engineering scored another success in helping Canadian Industry increase production, and manufacture improved, new products.

The custom-built co-ordinated motor drive and regulating equipment—G-E Motors, and Controls—were integrated to assure simplicity of operation and to yield consistent, high-quality production. This new mill will roll hot strip at 1,800 feet per minute—twice the speed of the former 4-hi mill. In addition to increased production, Dofasco now produces two new products with this equipment—hot rolled sheets and hot rolled strip steel.

The G-E Equipment driving and co-ordinating this new mill was developed expressly for this operation

by C-G-E Application Engineers. The result: highly consistent production quality, and low cost operations.

C-G-E Engineers have developed similar functionally-simple, automatic drive equipment for just about every type of Canadian industry. To discover how G-E Co-ordinated Equipment can increase efficiency in your plant, contact your nearest C-G-E office, or Apparatus Division, 212 King St. W., Toronto, Ont.



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Vacuum Metallizing

(Continued from page 39)

Unfortunately, aluminum and a few aluminum alloys are the only metals which will wet a tungsten filament properly. If a gold, copper, or silver staple were used instead of aluminum, the staple would melt in half and drop to the bottom of the chamber without wetting the tungsten filament or evaporating sufficiently to coat the objects within the chamber. This presents a problem when it is desired to use a metal other than aluminum. In printed circuitry, for instance, it is necessary to evaporate a thin film of copper on a phenolic sheet and then, by electroplating, build up a desired thickness of approximately 0.003 inch. Since it is very difficult to electroplate on aluminum, copper is generally used as the base metal. However, as mentioned above, copper cannot be evaporated from staples hung from filaments. To evaporate copper, it is necessary to form a Vee-shaped "boat" or trough from 0.005 in. molybdenum sheet and, by crimping the ends together and fastening them between the electrodes or filament holders in the chamber, current can be passed through the molybdenum sheet to make the "boat" incandescent. In this way, small pellets of pure copper, gold or silver can be placed within and evaporated from the molybdenum trough. These boats are usually about four or five inches wide and approximately $\frac{1}{4}$ in. to $\frac{3}{8}$ in. deep.

This method, however, has one limitation. As mentioned previously, the molecules of metal vapor travel only in a straight line from the vapor source. Therefore, when a molybdenum boat is used, the metal will vaporize only in an upward direction and objects mounted beneath the boat will not be coated. In order to coat all the objects mounted in the chamber and to use every available bit of space, it is necessary to mount the parts on rotating fixtures. Then, by a planetary gear system, all the fixtures are revolved within the chamber so that each set of racks eventually comes above the vapor source and rotates there.

The vaporization of the aluminum during the normal vacuum metallizing process takes only 10 to 15 seconds. Most of the time involved in a production cycle is required to get the proper vacuum in the chamber so that the flight of the metal vapors from the molten source will not be impeded by the few remaining air molecules.

As can be seen from the foregoing description, vacuum metallizing is an extremely simple process. No skilled labor is required. No buffing and polishing op-

(Continued on page 53)

Vacuum Metallizing

(Continued from page 52)

erations are necessary after plating to achieve a glossy surface, provided that the surface which has been vapor-coated was properly prepared. Here is where vacuum metallizing makes possible large savings in finishing costs as compared with electroplating.

Due to the fact that the aluminum film is so thin, in the order of 5 millionths of an inch, it exactly reproduces the surface on which it is deposited. Therefore, in order to achieve a simulated polished surface, a coating of lacquer or synthetic resin must be applied to the surface of the item being metallized. This lacquer coating actually serves two functions. As a sealer to prevent outgassing of plastic items, and also to provide a glossy surface which will fill in minor mold defects on the surface of plastic parts, zinc die castings or steel stampings. The application of this lacquer film represents the greatest problem. It is necessary to have an almost perfect lacquer coating for the best results. There can be no runs, orange peel, sags or dry areas.

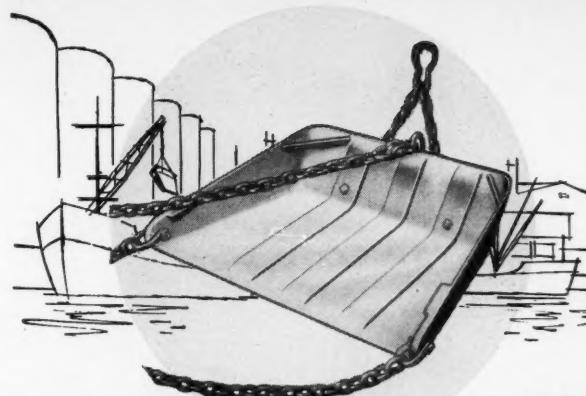
There are three general techniques in wide use today for lacquering. The first method is the conventional spray method which may either be by hand or by electrostatic application. Hand spraying requires the development of considerable skill and technique in order to achieve the desired result. Electrostatic spraying is excellent in many applications although there are certain disadvantages if the shape of the piece is such that the lacquer will not reach all surfaces.

A second method of lacquering is by dipping. This may be accomplished either by slowly withdrawing the parts from the lacquer tank, in order to eliminate runs, or by withdrawing the parts rather rapidly and removing the excess lacquer by spinning and then allowing the parts to rotate slowly to even out runs.

Either of these methods requires a considerable investment in lacquers, and it is generally recommended that the lacquers be filtered on a continuous basis in order to remove foreign particles which may lodge on the final film.

The third and most popular method is known as flow-coating. The parts to be metallized are first mounted on the appropriate racks, commonly referred to as "spiders," which are then mounted in a horizontal tank containing two or three gallons of lacquer. The lacquer itself is pumped by a positive displacement gear pump through a filter which delivers clean lacquer to a manifold mounted in the lid of the flow-coating tank and containing several spray nozzles located

(Continued on page 56)



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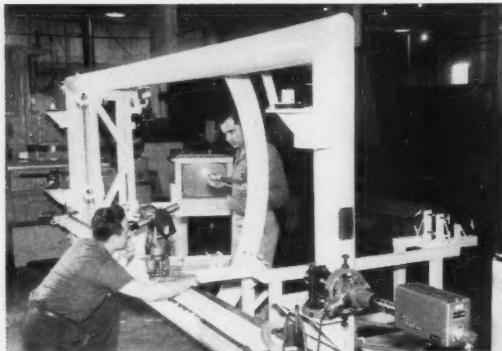
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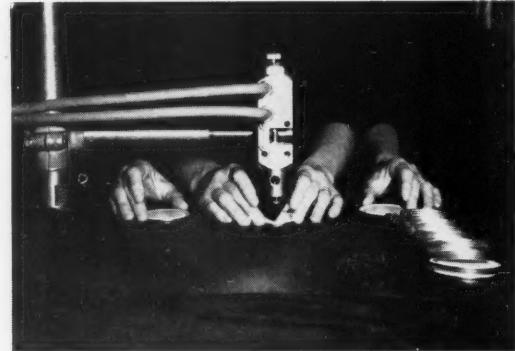


Design news in pictures

Some modern designs making news today



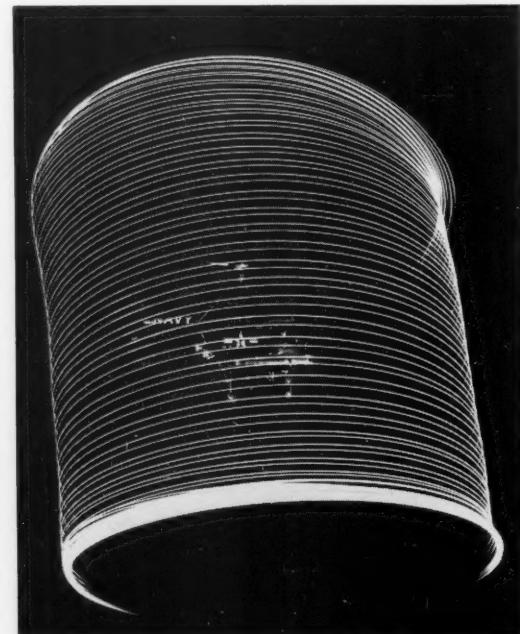
Data from the assembly jig for a DC-7C transport magnified 300 times on TV screen before him, an operator does his own alignment more accurately and quickly. Enlargement from 1/16-inch to 19-inch image eliminates eye strain, permits one to do job of several.



One pair of hands? Yes, but the motion study picture plays tricks. Darex flowed-in gasketing principle is shown as operator lifts part, puts it on chuck beneath nozzle. Foot control measures compound, then operator moves it to belt. When dry it forms a gasket.



Above, a quick, portable means of pre-testing sheet metal for its comparative drawing quality and stretcher strain characteristics is job of Steel City Testing Machines' new Flex-Tester, on right of Spherometer that measures curvature of the bend made by tester in "R's." Tester consists of base clasp, and indicator.



New blade-tip identification lamps for helicopter trace unusual pattern in time exposure. Lamps are capable of withstanding 1000 g, or 100 times the force of gravity. Heavy traces of light below resulted from 'copter hovering before ascending. Operating at 12 volts, the lamp is by Westinghouse and Kaman Aircraft.

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Vacuum Metallizing

(Continued from page 53)

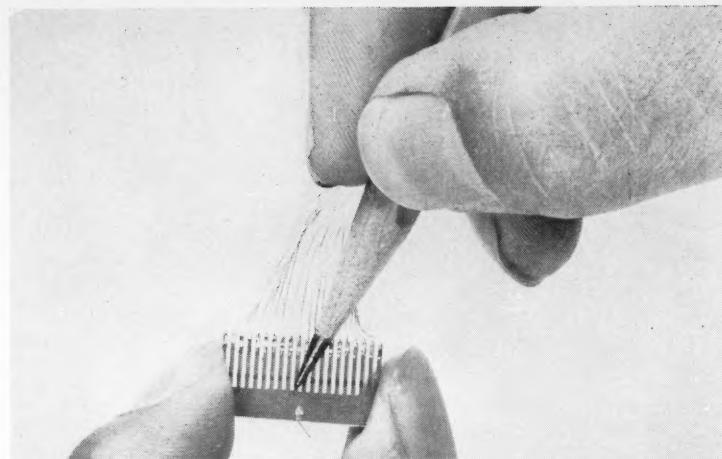
above the spider. The spider is slowly rotated while the clean lacquer cascades over the parts to be coated. After the parts are thoroughly washed with the filtered lacquer, the motor is shut off and the spider is spun rapidly to remove excess lacquer. The entire spider is then transferred to a rotator which revolves the spider at approximately 8 to 10 rpm for a 10- or 15-minute air-dry. This rotator evens out any lacquer runs and provides a smooth, glossy base coat of lacquer which will receive the metal which is vaporized in the vacuum chamber.

The base coat of lacquer must then be baked for an appropriate time, depending upon the material used. For most plastics, the baking time is about 1½ hours at a temperature of approximately 150 deg F. The top coat of lacquer, which is applied after metallizing, is either air-dried or given a quick bake of 10 to 15 minutes at 150 deg F. With metals, the base coat is usually baked for ½ hour at 300 deg F, and the top coat receives a similar treatment.

After the top coat of lacquer has been applied and baked for ten minutes, the appearance of the finished zinc die casting, steel stamping or plastic part is similar to polished chrome plating. It is then possible to dye the top coat of lacquer in a water-soluble dye to achieve any desired metallic effect. Simulated copper, gold, bronze, brass and other finishes can all be obtained quite readily with a few seconds immersion in the dye dip tank. After dyeing, the parts, still mounted on the original spider, are rinsed in water and then in a mild detergent to eliminate water spots and are then again placed in the baking oven. This sets the color and provides a more color-fast finish.

Vacuum metallizing units are available ranging in price from approximately \$12,000 to \$30,000 to meet different production requirements. Baking ovens, lacquering equipment, trucks, racks and jigging fixtures represent an additional investment ranging from \$5,000 to \$10,000.

(Continued on page 62)



Glass slips coated with lead sulfide used with relay made the box squeal

Photoconductive Cells See Infra-red To Master Delicate Industrial Feats

A SMALL BOX that emitted squeals when it "saw" the hot ash on the end of a cigarette amazed convention-goers of the American Society for Testing Materials last June.

Secret of the shrill outcry were little slips of glass coated with lead sulfide that are reportedly 10,000 times more sensitive than any previous photo-electric device. Connected to a relay in the box they forcefully demonstrated their ability to detect heat at various distances. This photoconductive cell also caused the box to emit a squeal when a flashlight with extremely weak batteries was pointed at it.

The cells, simple in construction, can be easily manufactured in any shape or size. This feature, coupled with the fact that the cells can detect warm objects over long distances without actual physical contact, opens wide possibilities for its use by design engineers.

For instance, the photoconductive cell could be used in the automatic control of chemical plant operations. There, it could automatically monitor the exact composition of the fluids flowing through pipes and process vessels. This would be possible through the cell's ability to detect the characteristic infra-red color of

the various components. In the case of water and gasoline, for example, where no color is apparent, the cell could detect very fine differences.

Photoconductors have the unusual property of changing resistance according to the amount of light striking the surface. In view of this, Canadian Marconi have applied their photoconductive cell to some of their TV sets. The minute cell automatically adjusts the brightness and contrast on the screen of the receiver according to the amount of light falling on its face.

The cell is adding new safety and comfort to night driving where it is connected to the automobile headlights. Gone soon will be the days when lights from an approaching car caused dangerous momentary blindness. Now the headlights are automatically dimmed in some cars when other autos' lights strike the cell.

Another use for the new cell is in a circuit where it can turn on street lights at dusk, then off again at dawn.

This is just the beginning of the potential of the photoconductive cell that will keep its eye on, not only the infrared, but all colors of visible light right into the ultraviolet range. ★

Solar Furnace

(Continued from page 28)

makes it easy to watch the focal spot from a ground position behind the mirror. Details of heating or melting are magnified about 20 times by a telescopic arrangement. The focal spot is kept in one location on the specimen since the

mirror is mounted on a gimbal ring with the polar axis of the mounting parallel to that of the earth's. An accurate clock mechanism, driven by a synchronous motor, co-ordinates the movement of the mirror with that of the sun.

The efficiency of the furnace is reduced greatly by the presence of sky haze and clouds. To overcome this problem, Convair plans to move the furnace from the city of San Diego to a

nearby mountaintop where conditions are found to be ideal.

At the Stanford Research Institute, a solar oven designed by Maria Telkes of New York University, consultant to the institute on solar energy, used four flat mirrors to direct the sun's rays into an oven. This produced a temperature of about 350 degrees F. Built during 1954, the oven will cook hamburgers in the near 400 degree heat collected. ★



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DESIGN ENGINEERING OCTOBER 1955

Quotes

Points from current papers and speeches

AN ARTICLE IN the Trend of Engineering (University of Washington, July 1955) deals with trussed columns.

The authors, S. Sergev and S. Rasul state that recent interest in the strength of trussed columns has motivated a theoretical study of this problem. Although it was known that bracing a column by trussing (or staying) increases its strength, the degree to which this effect occurs was less evident. Results of their theoretical investigation not only confirmed this conjecture, but indicated that the load-carrying capacity of a column, in some cases, can be nearly quadrupled by trussing it.

Consider a column, with round or hinged ends, with a spider, or diaphragm, normal to the axis of the column, situated somewhere between the ends. If bracing wires, or guy-wires, are attached to the ends of the column and held away from the column axis by the spider we have a stayed or trussed column. The trussing wires, or guy-wires, may have initial tension, be snug, or they may be slack. Trussed columns belong to the class of columns having a lateral support—in this case, at the spider. This support is provided by the trussing wires, the spider and the column itself, and under certain conditions may be yielding or non-yielding. A non-yielding support behaves as a rigid support but need not have an infinitely large stiffness or spring modulus. The yielding support is analogous to an elastic lateral support where the reaction is proportional to the displacement. In the former case, the column buckles into two half-sine curves, and in the latter into a single curve with lateral displacement at the intermediate support, or into two half-sine curves with a lateral displacement of the intermediate support. The column with the yielding lateral support, however, does support loads, whose magnitudes depends on the deflection.

Constructing the model

The model used was made of seamless steel tube with 0.625-in. outside and 0.5-in. inside diameters, and approximately 71-in. length between pinned supports. Trussing was accomplished by a four-way spider and 0.041-in. diameter steel piano wires. The angle between the column axis and trussing wires was changed by shifting inward or outward

small pulleys located in the spider arms. These pulleys also served the purpose of equalizing the tensions in the trussing wires each side of the spider. Initial tensions in the trussing wires were first measured sonically by comparing the tone of vibration of the trussing wires with the tone of vibration of a wire of the same length and known tension. This method, with an SR-4 resistance strain gauge mounted on the column for a check, proved quite reliable. However, as there was no way of measuring the tension in the trussing wires as loading was applied, and because the junior author insisted that he had no ear for music, it was decided to use strain-resistance gauges in each trussing wire. These gauges, which were designed by Professor Vassarhelyi, had a high degree of accuracy. They were mounted on thin brass strips, and were in series with the wire.

These test, intended for a pilot investigation with a modest goal, turned out to be quite conclusive. The results show that column strength is increased by trussing. For the practical range of angles, it may be said that the strength of a column can be at least doubled. When the angles are small, the tension in one set of the trussing wires or rods becomes large, and the strength of the column in that case, is dependent of their strength.

IN CIRCULAR NO. 66 of the University of Illinois Engineering Experimental Station, the axial variation of the magnetic field in solenoids of finite thickness is discussed by Dillon E. Mapother and James N. Snyder.

Tables are given which are a by-product of recent experience at the institution in the design of solenoids and also the circumstance that the University of Illinois high speed digital computer, the Illiac, was available. They have been compiled as an aid to the design of solenoids in which the effect on the magnetic field arising from the finite cross-sectional dimensions of the windings must be considered.

There is no shortage of ways to calculate the effect of winding thickness on the magnetic field of a solenoid. However, from the point of view of the practical designer, all methods have in common the fact that they require a large amount of computation, if a

fair picture of the resulting magnetic field is desired. These tables represent a frankly empirical approach to this problem. Using the computer facility, a function for the thickness correction has been tabulated for a wide range of solenoid lengths and cross-sectional dimensions. Within the range of tabulated values (which is believed to cover the majority of laboratory situations) the designer can obtain very detailed information about the magnetic field and the effect of winding thickness, with practically no calculation at all. The tables should also prove valuable in giving a quantitative impression of the importance of the thickness correction for increasing thickness of winding as well as for position along the axis.

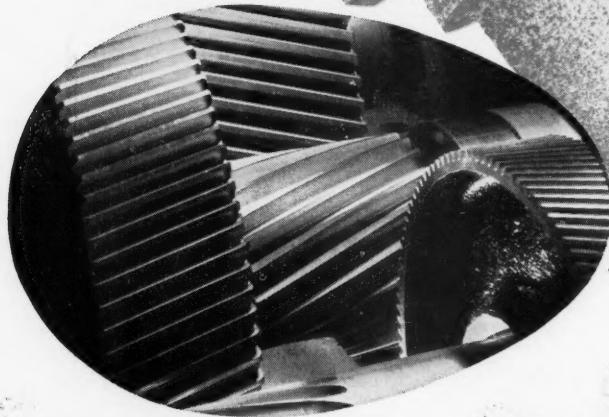
A PAPER read by J. C. Holzwarth, R. F. Thomson and A. L. Boeghold at a recent SAE meeting was a study of non-protective rust formation on auto-body sheet steel.

In a highly competitive industry like automobile manufacturing, one is much concerned with product corrosion, for this condition is extremely annoying to the customer and, hence, reflects unfavorably on the manufacturer. From time to time since 1940, the automotive industry has experienced a number of corrosion problems with automotive bodies, and in varying degrees of severity. While many improvements have been made to diminish the intensity of this problem, there would be considerable advantage to all if auto body sheet steel, in addition to its present satisfactory properties, had improved corrosion resistance.

According to industry reports passenger cars are being scrapped at the rate of about three million per year. Except for the small number scrapped as total wrecks, nearly all are rusted beyond economic repair. AMA figures further show that the average life of cars scrapped in 1925 was 6½ years, while the average age of cars scrapped in 1951 had increased to 13½ years. Longer life was primarily the result of improved durability of engines and other mechanical parts. In order that the service life of the body structure could be extended to keep pace with mechanical improvements, considerable emphasis has been placed on improving design and protective coatings. However, there has not been any significant improvement in corrosion resistance of the auto body sheet steel in the past half century.

This paper reports some recent observations on the rusting of low alloy steels in auto bodies and other environments where protective rust formation is not realized. The information gives a new insight into corrosion failure.

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A NEW CATALOGUE presenting design, application and use data for five types of needle bearing is being distributed by the **Torrington Company**.

The illustrated catalogue is in effect an engineering short course on bearings and aids the selection of needle bearings by type, size and suitability.

Index visual units provide quick identification of the various bearings and their main characteristics. Page designs, illustrations, indicators and thumb guides are keyed to the index and color coded, directing the reader to the product of specific interest.

On facing pages, dimensional data and product applications are given. Without referring to other pages, the engineer can see at a glance the bearing properly adapted to load and size requirements, as well as its exact mounting and other installation data.

Descriptive material on each type of bearing details design considerations, construction, materials and finishing, lubricating, housing and shaft requirements, fits, load capacities and recommended installation methods. Text, tables and cross-sections show bearing identification numbers, dimensions, recommended shaft diameters and housing bores and rated load capacities. Simplified scales permit checking bearings and proposed applications by capacity, speed and life factors. (207)

DETAILS ARE GIVEN in Technical Folder ST-53 of spiral tubing made by **The Diamond State Fibre Company**.

The tubing is made from special kraft papers, spirally wound, impregnated with high-grade electrical phenolic resins and cured.

The basic shapes are round, formed, formed and notched and square-rectangular.

The tubing can be used for coil forms, insulations, bushings or spacers, roll applicators, bobbin tubes and low-cost components for various assemblies.

The properties of the various grades are set out in the folder. (208)

A DATA SHEET on their new Series 1100 lightweight restrictor valves for 3,900 psi hydraulic service has been issued by **Aircraft Products Company**.

It describes and illustrates the valves which are available in both fixed two-

way and fixed one-way types, with either internal or external threaded ends for tube sizes of $\frac{1}{4}$, $\frac{3}{8}$ and $\frac{1}{2}$ in.

Complete specification tables are given which list materials of construction (aluminum, stainless steel or special alloy bodies); wide ambient temperature ranges of standard valves (from minus 65°F to plus 275°F); special models (able to withstand temperatures of 400°F); and weight of the valves (20% to 35% lighter than conventional models). (209)

DETAILS ARE GIVEN in catalogue No. 102 of clutches made by the **Formsprag Company**.

These clutches are built in bore sizes from $\frac{1}{4}$ in. to 12 in. External dimensions vary in diameter from $1\frac{1}{4}$ in. to $30\frac{1}{2}$ in. Capacity varies from a few pound-inches up to a million and a half.

Larger or smaller clutches for special applications can be designed and manufactured by the firm.

A full complement of sprags is inserted in the annual space between an inner and outer concentric race. Contact with both race surfaces is maintained by an energizing spring.

Torque is delivered from one concentric race member to the other through the full complement of energized sprags. When torque is applied through the driving member, the sprags are instantaneously engaged between driving and driven members . . . with complete absence of backlash. When torque is removed, all the sprags release instantaneously. (210)

CATALOGUE 50-J gives details of the **Cone-Lok Jig** by **N. A. Woodworth Co.**

The jig makes use of the braking power of perfectly mated male and female cones.

The male cone is formed on the horizontal pinion shaft and is a close fit on the female cone, which is an integral part of the base.

Two sets of cones are used, one on each end of the pinion shaft. These are actuated by the end thrust of a helical gear and rack.

Pressure on the cone faces is obtained by generating opposing forces by application of weight on the tray or pressure applied to the operating lever.

The locking effect is thus obtained on both the up or down stroke. (211)

Book Department

DYNAMICS OF MACHINERY

The book under review, by **A. R. Holowenko** and published by John Wiley and Son, deals with kinematics and force analysis and a departure from the usual text book presentation has been made by giving all the step-by-step free body diagrams as they might be made in a lecture and as they should be made by an engineer in his analysis.

Free body diagrams have not been restricted to forces; they are a necessary part of all topics treated in the book. It is hoped that the spirit of making and using free body diagrams will be contagious, since the habit of making them is such a vital part of any engineering analysis.

A variety of problems has been selected for illustration, although the slider-crank mechanism has been used extensively for velocity, acceleration, force and dynamic analysis. In doing this it is hoped that the engineer will recognize principles rather than specific problems and will realize that procedures are applicable to other types of problem. For instance, although the material on flywheels has been expressed in terms of an internal combustion engine and a punch press, the method of attack is the same for any type of engine when an energy reservoir is needed or where speed control within a cycle is desired.

Balancing of engines, with emphasis on means of balancing, together with balancing of rotating masses, are subjects which stem from the presence of acceleration, and therefore involve dynamics. Critical speeds or whirling speeds and torsional oscillations of shafts are just two topics in the field of vibration analysis.

No claim is made to any new material in the book, for the basic principles were formulated many years ago. The philosophy of approach to a problem has been the major concern of this book. Consequently, more than one approach to a problem has been used. Both analytical and graphical developments have been presented, not for duplication, but for a better understanding of the relations developed.

It is hoped that the reader will spend time on these alternate methods.

An assortment of problems has been included to give variety and an attempt has been made to classify the problems in order of difficulty.

Calculus, both differential and integral, has been used. In fact no attempt has been made to avoid mathematics.

The book is well produced and should be on the design engineer's shelf of reference books. The price is \$7.50. ★

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Silicone News

FOR DESIGN ENGINEERS

Silicone Fluid Used to Obtain More Uniform Gage Response

While the viscosity of most fluids changes with temperature, Dow Corning 200 Fluids have relatively flat viscosity-temperature slopes. This characteristic plus nonvolatility and excellent resistance to oxidation and mechanical shearing make these silicone fluids ideal for use as damping and hydraulic media in such devices as the dairy homogenizer pressure gage manufactured by Taylor Instrument Company.

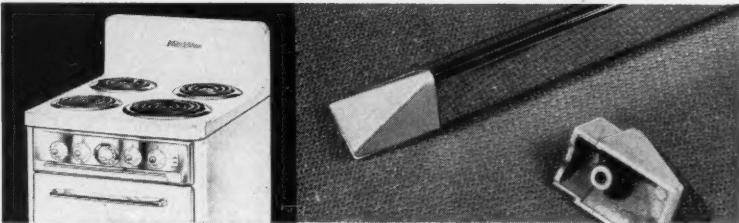


Initially, the hydraulic system used to translate volumetric pressures into the pinion-and-sector gear that controls the dial indicator of the gage, contained a glycerine and water solution. But the viscosity of the solution varied with changing temperatures causing the response time of the gage to vary accordingly.

After an adjustable orifice installed in the hydraulic system failed to solve the difficulty, Taylor engineers replaced the troublesome water solution with a Dow Corning 200 Fluid. Showing very little change in viscosity at operating temperatures ranging from 50 to 100 F, the silicone fluid keeps the gages operating uniformly in any dairy without further readjustment.

Taylor also uses two silicone compounds in the gage to assure accurate, dependable service. One of these materials, applied to the pinion-and-sector movement, dampens vibration and greatly lengthens gear life. Dow Corning 11 Compound is coated on the O-ring sealing the faceplate to prevent moisture from entering and fogging the glass.

No. 52



Silicone Finish Protects and Keeps Die-Cast Range Parts White in Spite of Oven Heat

With properties midway between those of organic paints and vitreous enamels, silicone-based finishes maintain the appearance and prevent the rusting of stacks, space heaters, jet engine parts or kitchen ranges. One of the early users of silicone-based paints on space heaters, Perfection Stove Co. of Cleveland, is now using them on die cast parts and accessories. Here's the story of one of their recent applications.

The oven door of one of Perfection's ranges is left ajar when the broiler is in

operation. This is done to keep the temperature in the oven below the point at which the oven thermostat is set to turn off the heat. A deflector bar is fastened above the oven door with two die-cast end brackets to protect the plastic control knobs against the heat that passes through the slightly opened oven door.

These brackets are painted white to match the rest of the range. When conventional paints showed signs of early failure, Perfection substituted a white Nubelon finish based on modified silicone resins and formulated by Glidden. This silicone finish shows no sign of cracking, peeling or browning even after long exposure to oven heat.

This is the way the finish is applied. The die-cast parts are degreased and given a phosphate surface treatment to improve adhesion. After heating for 15 to 20 minutes at 375 F, the parts are sprayed with the silicone finish, thinned 3 to 1. They are then baked for one hour at 375 F.

No. 51

44 Silicone Grease Used In Juke Box

The effectiveness of most organic greases is greatly reduced by unusually high or low temperatures. That is why semi-inorganic Dow Corning 44 Grease is the specified lubricant for the popular 80 record juke box produced by AMI Corporation of Grand Rapids.

Applied to the exposed moving parts of the music machine, this silicone lubricant withstands temperatures ranging from -40 to 350 F, assuring proper lubrication and trouble-free operation of installations in any climate.

Dow Corning 44 Silicone Grease has proved to be such an effective lubricant for this particular application that it has now become a standard practice for every AMI repairman to carry a tube in his regular repair kit.

No. 53

Design Edition 13

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Vacuum Metallizing

(Continued from page 56)

000. Thus, an investment of from \$17,000 to \$40,000 represents the capital outlay for a complete setup for vacuum metallizing. More complicated systems can be used, involving automatic conveyors, infra-red ovens, automatic spray equipment, and so on depending on the amount of automation and the volume of production desired.

Floor space requirements vary from 2,500 to 5,000 square feet for the most efficient operation.

Due to the fact that the entire vacuum metallizing process uses unskilled labor, highly paid "technicians" are not required, finishing costs represent a considerable saving over the costs generally experienced in electroplating, where hand buffing and polishing operations are required.

The material used throughout the process is also quite reasonable. For instance, about 10c worth of aluminum wire is used during each evaporation. This quantity of aluminum will coat 5,000 pieces of costume jewelry. Tungsten filaments cost \$8 per set and eight to ten shots are easily obtained from each set of filaments. The lacquer usually averages out to 25c or 30c per spider. As a result, the over-all cost of finishing the total load (six spiders full of parts) is in the order of \$2 to \$3 for all material. The main cost of the entire process is the labor required for racking the pieces, and the amount of labor is a function of the size of the piece and the number of parts which can be loaded within the chamber for a given cycle.

Low cost advantage

The principal advantage of the vacuum metallizing process centres around the low cost. Where highly polished chromium, nickel, brass or other metallic plated finishes are required, vacuum metallizing fills the bill without the need for the usual hand buffing and polishing operations. Admittedly, it is difficult to obtain "color toning" due to the fact that the lacquer film presents a smooth glossy surface over the entire area and thus toning cannot readily be achieved. The nearest approach to color toning would require a single wipe of a cloth on the aluminized film immediately after evaporation. This will provide a toning effect which, when covered with the top coat of lacquer, will very nearly simulate the effects achieved by the hand-toning operations associated with some electroplated finishes.

The versatility of the vacuum metallizing process is of extreme interest. Racking arrangements can be devised which

make the mounting of the parts extremely simple. The flow-coating method of lacquering is applicable to practically any shaped piece with the result that there are no apparent limitations to the process with respect to the complex shapes and so on which present serious problems to electroplaters.

The vacuum metallizing process presents unlimited possibilities with color finishes. The top coating of lacquer can be pigmented to simulate gold, brass or copper. Many other colors are possible by the "dye dip" method described above. The main objection to this dyeing method is the fact that, as yet, absolute color fastness has not been achieved. After a period of several months' exposure to direct sunlight, a piece which has been so dyed will fade. This difficulty is not encountered if pigmented top lacquers are used in the application of the top coat. However, care must be exercised

in applying pigmented lacquers due to the fact that recessed areas in the piece are likely to accumulate a heavier coating of lacquer than the smoother areas, which will give color differences.

It has its limits

It must be understood that vacuum metallizing will never completely replace electroplating. There are many applications where vacuum metallizing does not fit into the picture. These applications centre around products which require extreme resistance to impact and abrasion. It does not seem possible, at the present stage of development, that bumpers on cars will ever be vacuum metallized. While the coatings of lacquer are tough and durable, they can be gouged with a sharp edge and chipped by severe impact.

Aluminum die castings present a bit
(Continued on page 67)

Two Kinds of Protection

TO PROTECT a new product design, the obvious answer is to register it as an industrial design. But inventive features of a new design may be patentable too, and give you extra protection.

Because a designer can turn out a valuable invention without realizing it, the design should be checked for patentable ideas when the question of protection comes up.

An invention and a design often come together when the designer's plans for the final product can't be carried out in a well-known way: there may be a problem of construction for instance. Then he has to find an answer of his own, or else drop the design, and sometimes it's hard to tell where the design ends and the invention begins.

A good example of a combined design and invention is Charles Eames' classic molded plywood chair. His "shock mount" construction solved the problem of resiliently mounting thin plywood panels to metal or wooden frames. It is a typical inventive idea because it is a way of doing something that has a general application to many different designs.

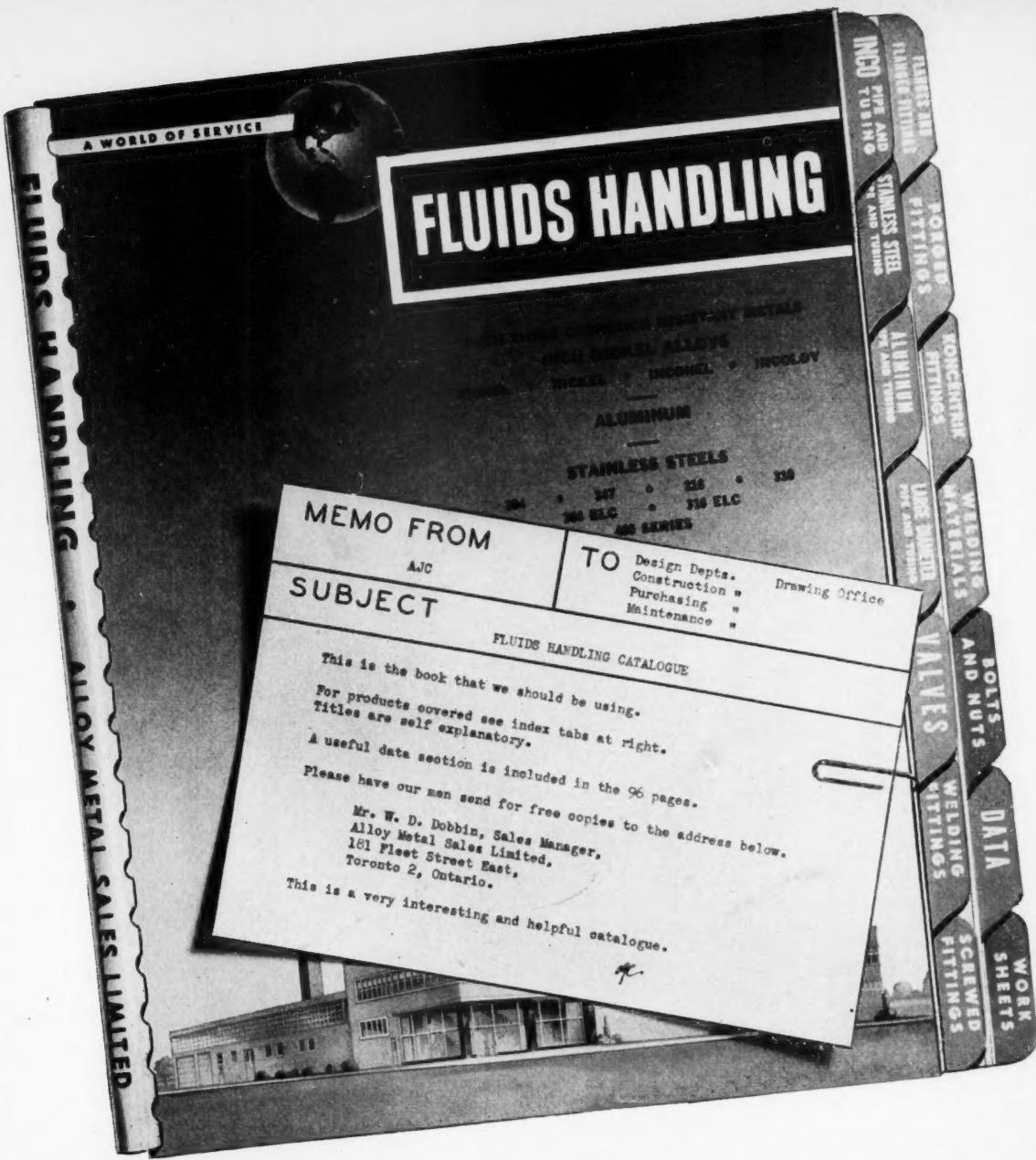
Eames was able to secure basic patent protection for his invention (United States Patent No. 2,649,136) and he used it in at least seven designs of chairs that he protected individually by design patents also.

The idea of the "shock mount" construction is simple: rubber blocks are bonded to the back or seat panel, with a nut embedded in each, so that bolts can be put through holes in the metal supporting frames and screwed into the nuts. This idea is quite general in nature and can be used to make flexible joints for a lot of different panels and frame combinations. For instance, some of Eames' chair designs have three legs, some have four. (This is where Eames the designer took over from Eames the inventor: deciding what shapes and materials for the panels and frames would perform best.)

Another example of a typical invention is the idea of the chair itself: the functional (and general) idea of a way to support the human body in a sitting position above the floor.

But a design, on the other hand, is a specific, concrete thing. It starts from a functional idea—a familiar one, like the idea of a chair, or an entirely new one (which is an invention), or a combination of both—and the designer's job is to design a specific structure to perform the function. The result usually can be registered as a design, but if a new functional idea is involved, more basic and effective protection may also be available by patenting.

(Contributed by Roy V. Jackson)



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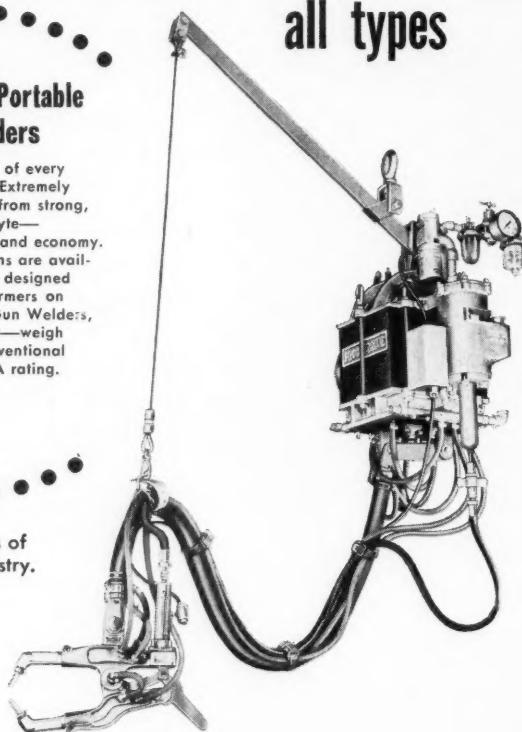
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Ultrasonics

(Continued from page 42)

lb, so that the unit is portable for mounting on a wheeled stand, or for suspension from an overhead rail, to save space and permit easy transportation throughout the plant.

A laboratory model for bench use is available, which includes supply vessels for feeding the continuous and disperse phases, separately or as a pre-mix, capable of processing batches of just over one gallon and operated by a one-half horsepower, 110 volt single-phase motor. Recirculation and continuous feeding are possible, so that this unit is suitable for research and development work and can also be used effectively for small production of low volume, high value materials, or for pilot plants from which full-scale operation can be planned without altering the developed processing technique.

Almost every week new applications are being tried and added to an ever-growing list. This ultrasonic method and equipment is the first step forward since the conventional piston homogenizers and colloid mills first appeared in the processing plant. It has brought increased efficiency to faster output, lower power consumption, with less cleaning and maintenance and much lower capital investment.

There is no longer any doubt that both small and large processing manufacturers stand to gain a great deal in their existing production and in their development of new products by taking a close look at their present methods and comparing them with the many obvious advantages of mechanical ultrasonic processing. *

Circuit Breakers

(Continued from page 45)

the phase-to-earth voltage on either the primary or secondary side of the transformer.

As well as the tests at Fontenay, an exacting series of short circuit tests, up to 100% rating, by the unit method of testing was carried out successfully at the Switchgear Testing Company, Manchester. The testing program included tests ranging from 0.04% breaking current

to 100% breaking current at 100% unit recovery voltage; single-phase short circuit breaking tests at over-voltages up to 323 kv across one pole; instantaneous auto-reclosing, short-circuit tests; and tests at low currents with low oscillating restriking frequencies. Over the complete range of tests the short circuit break time did not exceed three cycles.

At present, these breakers are being supplied by BTH for 220-kv, 275-kv and 345-kv service and research and development is proceeding for even higher transmission voltages. *

Vacuum Metallizing

(Continued from page 62)

of a problem in that the base coat of lacquer tends to be absorbed into the die casting, with the result that it does not provide a smooth, glossy finish. Two or three base coats of lacquer are generally required in order to achieve the desired glossy base coat on aluminum.

Powdered metal parts offer the same objection in that they are porous and two or three coats of base lacquer are required before the seal is complete and a glossy finish is obtained. *

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New products & materials

New items which can help you on the job

A NEW HYDRAULIC power pump weighing only 50 lb and controlled by two simple foot pedals has been developed by **Columbian Vise and Manufacturing**.

Originally designed for operation of the company's hydraulic vises, it is now being used in other capacities.

One pedal applies the hydraulic pressure at any desired level and the other acts as a power release also to provide constant control while pressure decreases.



Foot Controlled Pump

Featuring a single replaceable valve cartridge, including the main check valve, release valve and bypass relief valve, the pump is reputed to have a longer working life than other units of similar type. At the same time any necessary replacements are made more easily.

Designed as a two-stage dual piston type, the pump operates with both pistons at low pressures and produces one cubic inch per stroke. At high pressures only one piston operates producing a volume of .1553 cubic inches per stroke. Total potential pump discharge is 50 cubic inches, and the maximum hydraulic pressure is 7,000 psi. (200)

• • •

A NEW FASTENING device, the Paneloc rotary latch, is announced by **Scovill Manufacturing Company**.

According to the company, manufacturers have been seeking a simple and cheap, yet strong and durable, fastener for use on hinged or removable parts, such as inspection doors, access panels, covers, electrical control panels, machinery doors and so on.

Made of cadmium plated steel, the latch consists of four parts; latch-screw,

shin-plate, anchor-block and latch-nut. The entire latch is assembled on the access panel only. This does away with several of the operations needed to install other types of fastener. Three standard sizes are currently available. (201)

• • •

A NEW SPRING, with built-in valve for damped return to cushion impact, has just been made by the Hydra Spring Division of the **Wales-Strippit of Canada Ltd.**, specialists in machines and compressible materials.

This new device, with its low mass piston, provides high frequencies and is claimed to perform better than mechanical springs plus shock absorbers. Using the compressibility of a liquid called Wales Comproils, this small, self-contained, dual action unit gives a force of 3,600 lb on a 1-in. stroke. Dimensions are: 4 $\frac{3}{4}$ in. long (including 1 in. stroke) 2 $\frac{3}{4}$ in. diameter. (202)

• • •

A NEW AUTOMATIC-CYCLE tube-bending machine, that will simultaneously form two 180-deg hairpin bends in ferrous or nonferrous finned or plain tubing in less than three seconds, is announced by **Walter P. Hill, Incorporated**.

Insertion of the tubing into the machine initiates an automatic cycle in which the tubing is bent and then ejected.

The compact machine has a welded base for housing the electrical controls and a built-in hydraulic pump, motor and tank unit.

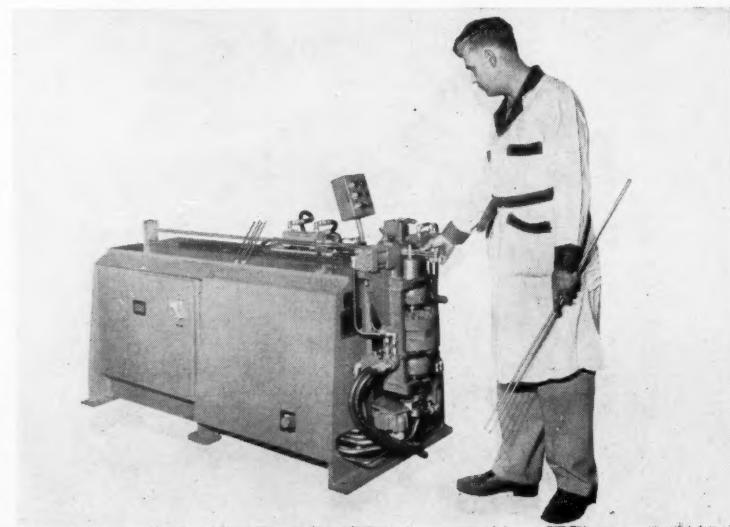
A bending table on the end of the machine is powered by a high-torque, positive displacement, single-vane hydraulic actuator. A radius bender block and a hydraulically controlled clamp block are mounted on this bending table. A wiping block is mounted on the machine base in contact with the radius bender block. This arrangement enables the machine to bend light-wall tubing on small radii without flattening or lengthening, and without the use of ball mandrels.

Manual insertion of the tubing causes the hydraulic cylinders to position the clamp and wiping blocks. Then the tubing is bent by radial movement of the bending table. The tubing is released, ejected and manually removed before the bending table returns to its starting position.

In the operation shown, two $\frac{3}{8}$ -in. diameter copper tubes, of wall thickness 0.016 in., are bent to form 180-deg hairpin bends and the legs leveled before ejection. Tube support mandrels are provided for each tube. The machine will also handle $\frac{1}{2}$ -, $\frac{5}{8}$ -, and $\frac{3}{4}$ -in. diameter tubing with minor clamp and radius block changes.

The machine has a single-tube capacity of up to 1-in. diameter ferrous or nonferrous finned or plain tubing. The centre-to-centre bend radius that can be formed on the machine is proportional to the tube diameter and wall thickness. Bends having legs up to 4 ft in length can be handled by the machine.

A 5-hp motor and 12-gpm pump provide hydraulic power for the actuator and clamp cylinders. The tube bending machine takes up a floor space of about 30 in. by 72 in. and is 32 in. high. (203)



New automatic-cycle tube bender

New Products

(Continued)

A NEW ZINC-MAGNESIUM-aluminum forging has been developed by **Aluminum Company of America**. Known as X79S, it is being used in the CL-28 conversion by Canadair, instead of the DTD 683 forgings used by the Bristol Aeroplane Company's design engineers on the Bristol Britannia.

Large aluminum forgings like those used on the undercarriage of the Bristol Britannia have always been a problem because of residual stresses due to quenching.

Now, the X79S forgings exceed 75 ST allowables in the larger sizes, and experiments over the past two years show the same basic fatigue properties as 75 ST and indicate lower stress-corrosion tendencies.

Lower sensitivity of X79S to mass quenching effects is said to be due to the lower chromium content. (204)

* * *

A HIGH-AMP PORTABLE electric welder, which may be used successfully by an inexperienced operator, has been put on the market by the **Sittler Corporation**, who claim it will out-perform any other welder of its type.

Weighing only 55 lb., the "Hi-Amp Model 5403" as it is known is designed to give a higher rate of production on light gauge metals. Its output is 3 amps for secondary open circuit voltage and over 20,000 amps for a short circuit.

A built-in electronic thyatron timing control and solenoid contactor gives a welding accuracy from 1/10 of a second to a full second. This prevents any danger of burning through the work.

By the use of extension arm accessories, the unusually wide throat depth of 6 in. can be extended to 18 in. In addition, the welder features water cooled transformer and welding arms, and floor stand for foot operation. (205)

* * *

A COMPACT NEW solenoid made by **Dormeyer Industries**, is now available for use when high power and rugged performance are required but there is little space to put it in. The shading coil is embedded in the plug for greater efficiency and high seated pull. It works in any position and is supplied (as standard) with solder terminals or with flexible leads.

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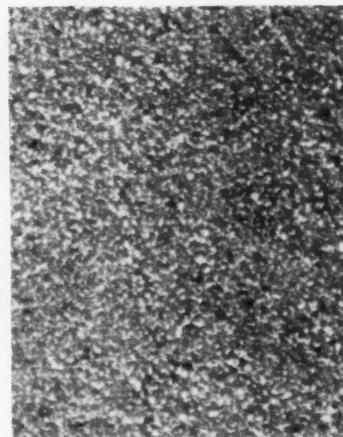
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Miniature Tubes

(Continued from page 48)

considerable importance, particularly since the small size of the hearing-aid case does not allow the use of a battery of large capacity. The filament power required to operate these tubes has been continually reduced. The reduction in filament power has progressed along with the reduction in bulb size. The first tubes, in the one inch diameter glass bulb, used a filament operating at 2.0 volts and 60 milliamperes and at the time these were hailed as low drain tubes. The miniature tubes for portable operation have a filament rated at 1.4 volts and 50 ma, while the original subminiature tubes had a filament at 1.25 volts and 30 ma. The filament power has since been reduced even more, and there are now tubes that will operate at 0.6 volts and 7.5 ma. The filament wattage in the latest subminiature tubes has been reduced by a factor of twenty-five from the power required for the original low-drain tube.

Subminiature tubes are made by the same process as other tubes. The assembly and processing of the small parts

is much more critical than for larger tubes. In general, the wire used in grid windings is smaller than a human hair and the wire for the filaments has an even smaller diameter, a size approaching a ten thousandth of an inch, which is only a few times the wavelength of light. The assembly of some of these tubes is conducted under binocular microscopes.

The low filament power in some subminiature types requires that great care be taken with filament activation during exhaust and at filament activation after exhaust, as well as during the processing of parts before assembly. At the low filament operating wattage, there is little heating power to spare. Emission must be kept under close control, to make sure that is enough for service operation.

The high bulb temperature in some of the higher power subminiature tubes will accelerate the evolution of contaminants that are occluded in metal parts. Consequently the pre-assembly processing and metal degassing during exhaust is more rigorous than is necessary for larger tubes. *

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In this engineering triumph, rising out of the peaceful countryside of New York State, a search will soon be under way to find further secrets of atomic power below the sea. *



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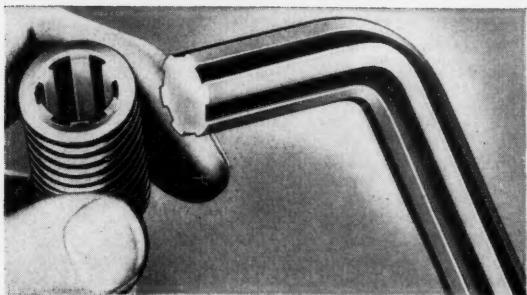
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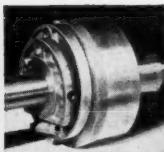
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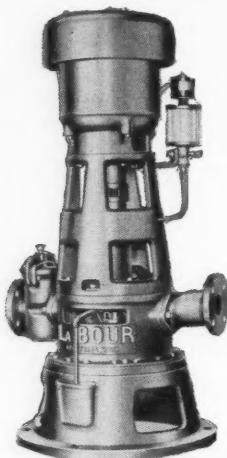
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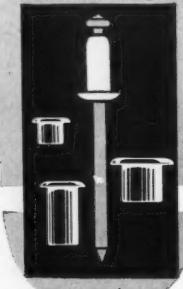
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Our steady expansion program is creating more positions for advertising salesmen who have management potential.

We are always glad to see men who have proven sales record.

Maclean-Hunter have a well-earned reputation for congenial employment. One in eight members of our staff belongs to our Quarter Century Club.

Our advertising salesmen work on a generous salary plus commission basis. Our company also makes substantial contributions to hospitalization, life insurance and pension plans.

We offer most attractive careers. All of our publication managers and other senior executives started their careers with us in a junior capacity, some even as messenger boys. Every member of our staff has the same opportunity to reach the top if he has ability matching his ambitions.

What have YOU to offer?

Why not write and tell us about yourself, your experience, education, age, marital status—and your ambitions. Better still, if you happen to be in Toronto at any time, drop in and see us.

We shall, of course, respect your confidence.

B. A. LAWLESS, Personnel Manager,

MACLEAN-HUNTER PUBLISHING COMPANY LIMITED,

481 UNIVERSITY AVENUE, TORONTO 2

EMpire 3-5981, local 208.

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Component parts or complete products—perhaps they can be made faster, better, less expensively of PLASTIC! If they can, French Ivory can tell you so. Designers, engineers, purchasing agents are invited to inquire without obligation.

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Editorial

For Best Results Defog Your Technical Writing

ENGINEERS USUALLY MAKE a poor show of technical writing. No matter how well they know their stuff engineering-wise, few of them seem to have the knack of writing a colorful and effective article.

There are, of course, notable exceptions. A past master in the art is S. Timoshenko, to whom a great debt is owed for his books on Structures.

Another notable exception is Dr. J. W. Mellor whose treatises on chemistry have laid the foundation for teaching throughout the world. And there are others.

In these times, with the rapid advances that are being made in matters technical, it is vitally important that engineers should be able to write clear and concise reports, with a minimum of complex words. As far, that is, as the technical nature of the subject will allow.

Apart from any other considerations, an engineer should be able to write well enough to do justice to himself and to his company. A badly written report cannot fail to give a poor impression all round. One way of improving the result is to use short sentences having 20 words or less. Another way is to substitute a single word for a group of two or three or more. For instance, get away from clichés such as "in view of the fact that" by using just "because" or "since." For "of the order of magnitude of," use "about," and so on.

Gunning, in his book "The Technique of Clear Writing," explains his method

of defogging. His working rule is as follows: Take more than one hundred words and work out the average sentence length. Then take exactly one hundred words and count the polysyllables, that is, words with more than two syllables. Add these together and multiply by the factor 0.4. This gives the fog rating. Aim at 8 or 9 and worry if it is anything over 11.

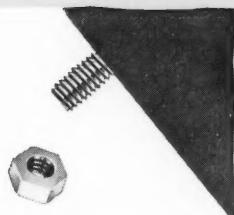
The importance of good technical writing is now well recognized in some quarters. The Canadian Welding Society, for instance, has inaugurated a technical paper competition on welding subjects. The ASTM has a scheme on foot for evaluating papers, a plan which it is hoped will give livelier and more stimulating sessions by improving the character of the technical articles.

Then again, Consolidated Engineering have set up a special editorial unit charged with the job of showing engineers and staff writers how to make their writing easier to read. Many other firms could do worse than copy this idea!

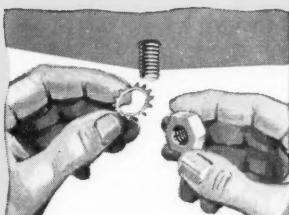
There is a saying that everyone has it in him to write at least one book, but most people are too busy even to contemplate doing this.

However, every engineer has his own pet subject and it should not be too much to expect him to write an article on it. Not only will this give him great personal satisfaction, but it will also be likely to help other engineers who have not had his own particular experience.

Why KEPS® save time...stay tight!



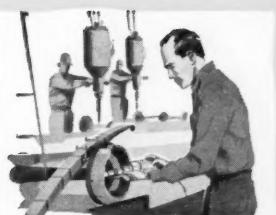
Loosening of ordinary nuts due to vibration is both dangerous and costly.



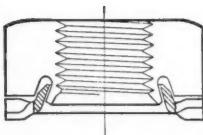
Lock washers are essential for most applications, but often hard to handle.



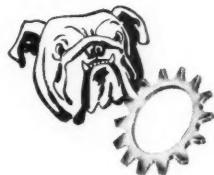
... except when nuts and lock washers are PRE-ASSEMBLED ... as KEPS.



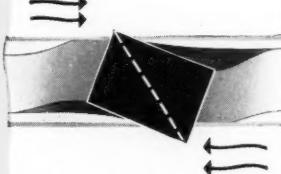
Then, awkward and costly separate lock washer handling is eliminated.



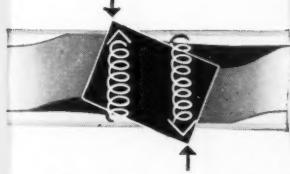
Nut and lock washer are mechanically pre-assembled as an integral unit.



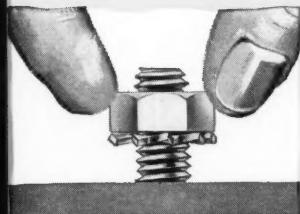
Shakeproof Lock Washers on KEPS lock tight because the teeth bite.



Tapered-twisted teeth bite deep to set up powerful resistance to any backward rotation.



Spring tension makes each tooth bite even deeper as vibration increases.



Starting KEPS is easier ... Free running action makes driving faster, saves assembly time.



Washers can't drop off, can't be wasted or "forgotten."



Standards and specials meet a wide variety of requirements.



With KEPS, you get tight, efficient fastening every time.

**Free
Sample
Kit**



Now ... make your own tests! See for yourself how KEPS can save time in the assembly of your product. Write for your free sample kit today!

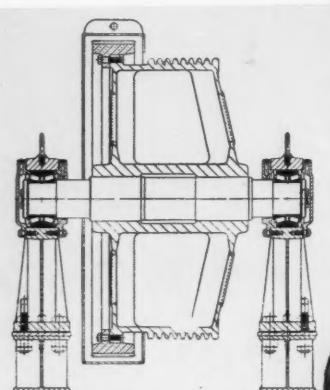
WORLD'S BROADEST LINE OF
ASS-ASSEMBLY FASTENINGS



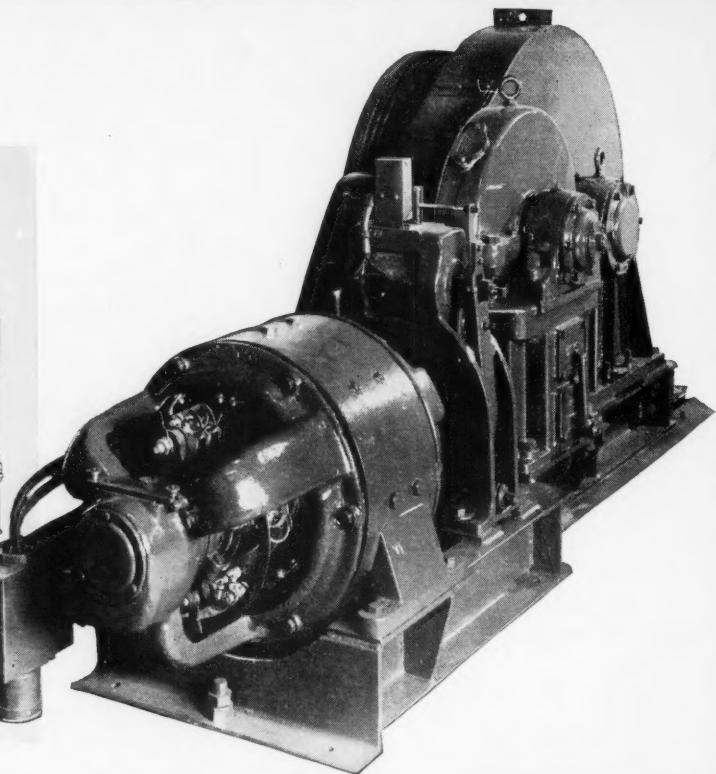
Citeo

CANADA
ILLINOIS TOOLS LIMITED

177 FRONT STREET E, TORONTO 2, CANADA



OTIS ELEVATOR COMPANY LIMITED cuts friction and power loss in its hoisting machines by using Timken bearings to take side thrust of the sheave driving shaft.



How TIMKEN bearings cut friction and power losses in Otis Elevator hoisting machines

ENGINEERS at Otis Elevator Company Limited had the problem of side thrust in designing their hoisting machines. Especially on the driving sheave shaft in the larger models. Unless this thrust was handled efficiently, there would be high friction and resulting high power loss.

Otis engineers solved the problem by equipping these hoisting machines with Timken tapered roller bearings. And they get the following results:

1. Less friction loss and therefore less power loss.
2. Elimination of the need for a separate side thrust unit on the sheave shaft.
3. Easy adjustment of wear between

worm and gear by simply lowering the pillow block which retains the roller bearing, instead of having to reabbott the bearing.

4. Reduction of shutdown time.

Timken bearings can deliver these advantages because they can take thrust as well as radial loads, in any combination. And full line contact between rollers and races gives Timken bearings extra load-carrying capacity. In addition, Timken bearings practically eliminate friction with their true rolling motion. The result: Otis hoisting machines operate smoothly, easily.

Other advantages are low maintenance and lubrication costs. Timken

bearings hold housings and shafts concentric, making closures more effective. Lubricant stays in—dirt stays out.

It's easy to understand why Otis, like so many other manufacturers of fine machinery, uses Timken bearings. They last longer, for the life of the machines, make machines run better, cost little to maintain. Whether you buy or build machinery, it will pay you to see that it is equipped with Timken bearings. The Timken Roller Bearing Company, Canton 6, Ohio. U.S.A. Cable: "TIMROSCO". CANADIAN PLANT: St. Thomas, Ontario.



This symbol on a product means its bearings are the best.

TIMKEN *Made in CANADA*
TAPERED ROLLER BEARINGS
FOR CANADIAN INDUSTRY



NOT JUST A BALL ◎ NOT JUST A ROLLER ◎ THE TIMKEN TAPERED ROLLER ◎ BEARING TAKES RADIAL ◎ AND THRUST — ◎ LOADS OR ANY COMBINATION ◎

